TURFGRASS RESEARCH CONFERENCE AND FIELD DAY

September 15, 1992

AND

LANDSCAPE MANAGEMENT RESEARCH CONFERENCE AND FIELD DAY

September 16, 1992

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BIOLOGY AND CONTROL OF KIKUYUGRASS

Jodie S. Holt, Cheryl A. Wilen, and David W. Cudney[1]

UCR's research project on kikuyugrass focuses on this species as both a weed and a potential turfgrass. This abstract summarizes the portion of the project focusing on kikuyugrass as a weed. The objectives of this work are twofold: 1) Study kikuyugrass biology, particularly environmental responses of growth and reproduction, in order to provide information for development of cultural management as well as weed control strategies (JSH and CAW); 2) Study various herbicides, mixtures of herbicides, and the interaction of herbicides with cultural treatments for the control of kikuyugrass (DWC).

A field experiment was conducted to examine the spread of two clones of kikuyugrass, one with upright growth habit and one with spreading growth habit, as influenced by weekly cutting height. Plants were sampled monthly 0, 45 and 90 cm from the center and divided into aboveground and belowground parts for analysis. A second field experiment was conducted to examine effect of time of removal of aboveground parts on regrowth. Simultaneous greenhouse studies were conducted to evaluate dry matter and starch content of plants and plant regrowth following top removal.

Results of the field experiments are still being analyzed but preliminary conclusions can be drawn. The two clones differed in amount of spread at each cutting height at the beginning, middle and end of the experiment. As would be expected, the plants extended farther from the center with each time period. The farthest extension of stolons occurred in unmown plants and the least in plants cut to 2.5 cm height. Thus, close mowing at weekly intervals removed enough nodes to impact spread of kikuyugrass. This was substantiated by data from the harvest at the end of the experiment. Analysis of variance indicated that the lower mowing height significantly reduced the weight of shoots and the number of nodes compared to the 5 cm height or the unmown plants. However, root weight was not affected by mowing height.

Results from the second field experiment showed no diffeence between cutting treatments or harvest date in amount of biomass regrowth that occurred after two weeks, indicating that regardless of age, kikuyugrass regrew immediately following mowing. Even as early as three weeks after planting, regrowth occurred from established belowground parts following mowing. These results indicate the need for control practices which include destroying perennating material such as stolon pieces or rhizomes even on young plants.

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Associate Professor of Plant Physiology, Graduate Research Asst., and Extension Weed Scientist, Botany & Plant Sci. Dept., UC Riverside.

Results of the greenhouse experiment differed from those of the field experiment in that leaf regrowth following clipping, increased with plant age at clipping. In this case, the clipping treatments were closer than 2.5 cm; thus, it is possible that close mowing may be used to impact kikuyugrass regrowth. A similar result was found in starch content of rhizomes following a period of regrowth. Kikuyugrass was remarkably rapid in its ability to establish and begin storing photosynthate within 4 weeks of planting.

Plugs of perennial ryegrass, tall fescue, Kentucky bluegrass, common bermudagrass, hybrid bermudagrass, and zoysiagrass were planted into an established kikuyugrass sward. Herbicide treatments (MSMA, triclopyr, MSMA plus triclopyr, and quinclorac) showed significant differences for herbicide treatment, turf cultivars, and the interaction of turf cultivars and herbicide treatments. All of the herbicide treatments reduced the competitiveness of the kikuyugrass relative to the turf species. In trials established in Camarillo and Huntington Beach on swards consisting of 85% kikuyugrass and 15% mixed Kentucky bluegrass and perennial ryegrass, one application of any of the herbicides or combinations (MSMA, triclopyr, fenoxaprop, quinclorac, MSMA plus triclopyr, and triclopyr plus quinclorac) did not affect kikuyugrass beyond the initial, temporary phytotoxicity. After four applications, MSMA, triclopyr, and fenoxaprop had reduced kikuyugrass to less than 15% of the respective swards. Quinclorac and the combination treatments had reduced kikuyugrass to less than three percent of the sward.

KIKUYUGRASS IMPROVEMENT

Ruth G. Shaw and Matthew K. Leonard[1]

Kikuyugrass is a warm-season species that is well adapted to a wide area of California. It produces adequate turf under proper management, exhibits better winter color retention than most warm-season turf species, and is physiologically adapted to use water efficiently. Our breeding program is aimed at alleviating objectionable attributes of KKU (e.g., aggressiveness and course texture) to eliminate these obstacles to its general acceptance as a turfgrass species. During the three years of our breeding program, we have conducted a variety of studies, including the following:

1) Using a replicated field trial, we examined 21 naturalized kikuyugrass accessions collected from around the state of California. Measurements of leaf width, stolon diameter, and stolon internode length revealed significant differences among accessions for all traits. These differences indicate that the naturalized populations of kikuyugrass in California constitute a highly variable gene pool with broad-sense heritability of 50% for internode length and 70% for leaf width and stolon diameter.

2) We have screened seed obtained from a polycross made during 1983-84 for shoot number, plant height, and plant width. Plants exhibiting the desirable extremes of these traits, particularly in combination, were retained at the end of the evaluation period. Of the first 400 plants screened through the end of 1990, 17 were saved for further study. The screening of this plant material is still continuing.

3) We performed a replicated greenhouse study to test the stability of seedling traits, and hence, to make selections from unreplicated seedling material. Plants previously evaluated as having high shoot density retained this rating. This study, therefore, indicated that phenotypes assessed in the seedling selection process were stable under greenhouse conditions.

4) We conducted a replicated field trial of the 17 advanced seedling lines (see #2) and three California selections. Of particular interest was how consistently the traits observed in the greenhouse would be expressed under field conditions. All three California selections spread faster than the UCR selections. Moreover, almost all of the UCR selections exhibited higher density than the California selections. Among the UCR selections, the lines exhibiting the greatest number of shoots in the greenhouse were also among the densest selections in the field, and there was a negative correlation (r = -0.57) between total plant area and density, indicating that slower spreading plants tended to have higher turf density. This information was also important, since it demonstrated that the breeding goals of less aggressive growth and increased density were compatible.

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Geneticist and Staff Research Associate, Botany & Plant Sci. Dept., UC Riverside.

Finally, several UCR lines exhibited excellent dark green color, and these tended to be slow growing, high-density lines. The darkest green selections also maintained the best winter color quality.

The UCR breeding program has made great progress toward producing kikuyugrass with more desirable turf characteristics.. New lines have been developed and identified that exhibit less aggressive growth, increased turf density, finer leaf texture, reduced vertical growth, and improved color quality. The extent to which many of these traits are already combined in certain lines is very encouraging and promises rapid progress toward species improvement in the future.

THE FATE OF CHEMICALS AND FERTILIZERS IN A TURFGRASS ENVIRONMENT

M. V. Yates[1]

The purpose of this research project is to study the fate of pesticides and fertilizers applied to turfgrass in an environment which closely resembles golf course conditions. The goal is to obtain information on management practices that will result in healthy, high quality turfgrass while minimizing detrimental environmental impacts. The specific objectives of the project are as follows:

1) Compare the leaching characteristics of pesticides and fertilizers applied to two turfgrass treatments.
2) Study the effects of the soil type and irrigation regime on the leaching of pesticides, nitrates and phosphorus.
3) Compare the leaching characteristics of nitrates from different fertilizers.
4) Measure the volatilization rate of pesticides from turfgrasses into the atmosphere as a function of time since application.
5) Monitor the effects of different irrigation regimes, fertilizers, and soil types on the quality of the turfgrass.

At this time, site construction has been completed. The sod (Penncross bentgrass on the green plots and Tifway II hybrid bermudagrass on the fairway plots) was installed in early February. Porous metal or ceramic suction cups have been installed in all plots to enable the collection of soil water samples. Drainage water samples are also collected on a weekly basis to monitor the concentrations of nitrate, phosphate, and pesticides that are leaching through the soil profiles.

Two irrigation treatments were started in April. One half of the plots are irrigated using an optimum water level (100% ET_c); the other half of the plots are being irrigated at 30% more than the optimum level (130% ET_c). The water requirements of the two turfgrasses are determined weekly using a weather station located at the site.

Fertilizer applications were initiated on April 17, 1992. The fertilizer rates are 1 lb N/1000 ft^2/month and 0.5 lb N/1000 ft^2/month, for the green and fairway plots, respectively. Two fertilizer treatments have been established, resulting in one half of the plots being fertilized with urea and the other half with sulfur-coated urea. Plots are individually fertilized to ensure even application two times per month.

Analysis of the drainage samples prior to initiation of fertilizer treatments showed a wide range of nitrate concentrations, from less than 1 to more than 1000 mg/l NO_3-N. Phosphate concentrations in the drainage water samples also varied from

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Ground-Water Quality Specialist, Soil & Environmental Sci. Dept., UC Riverside.

plot to plot, with a measured range of less than 1 to 17 mg/l PO_4-P. The volume of water draining from the fairway plots (which have relatively higher nitrate concentrations) is much less than that from the green plots (which have lower nitrate concentrations). In the future, drainage volumes will be measured so that the mass of chemicals leaching from the plots can be calculated to give a more precise picture of the environmental impacts of the various treatments.

EFFECTS OF NITROGEN AND POTASSIUM ON ROOTS OF TURFGRASSES SUBMITTED TO SPORTS TRAFFIC

S. T. Cockerham, V. A. Gibeault and M. Borgonovo

Santa Ana hybrid bermudagrass and a mixture of perennial ryegrass plus Kentucky bluegrass were established as separate plots on a sand-filled basin sports field model. Nitrogen (N) at 1.0 lb N/1000 sq ft as ammonium sulfate and potassium (K) at 1.0 lb K_2O/1000 sq ft as potassium sulfate were applied monthly in replicated plots alone and in combination (N+K) to each of the sports turf surfaces. Traffic was applied across half of each treatment with a Brinkman Traffic Simulator (BTS) at the rate of six football game-equivalents per week. The plots were evaluated by taking turf score ratings, Clegg impact, traction plate, and root densities. Root density was measured as dry weight of washed roots in the upper 2.0 inch (5 cm) and in the next 6.0 inch (15 cm) of a 3.0 inch (7.6 cm) diameter plug.

HYBRID BERMUDAGRASS. The differences between the traffic and non-traffic treatments were great, as expected, with the traffic obviously injuring the turf. Within the non-traffic treatments, the N treatments were higher in turf scores, there were no differences in the Clegg gMax, and the only significance in the traction was with the higher values in the N applications.

Turf scores were generally lower on the traffic plots with no significant differences in the nutrition treatments with the control mean ranked lowest. The traffic treatments overall were significantly harder (lower Clegg gMax) than the non-traffic, but there was no significance between the nutrition treatments.

Hybrid bermudagrass roots in the upper 2 inch were significantly greater in both traffic and non-traffic controls followed closely by the N+K treatments. Roots in the next 6 inch were significantly higher in the traffic N+K treatments and not different in non-traffic.

PERENNIAL RYEGRASS/KENTUCKY BLUEGRASS MIXTURE. The differences between the traffic and non-traffic were apparent, but not as great as expected. N treatments rated highest in the turf scores of both traffic treatments. There was no significant difference in Clegg gMax or traction. Turfgrass roots in the upper 2 inch of non-traffic were not significantly different. In the next 6 inch the N+K roots were significantly greater with N as the lowest rating.

In the traffic treatments the turf score ratings of the control and K alone decreased significantly. The Clegg gMax was highest (hardest) in the N+K followed in descending order by N, K, and control. The N+K traffic treatment traction was significantly higher than the other treatments, with N greater than the K and the control. Roots in both the upper 2 inch and the next 6 inch were significantly greater in the N+K treatments followed in descending order by the N, control, and K treatments.

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Supt., Agric. Operations, UC Riverside; Ext. Environmental Horticulturist, Botany & Plant Sci. Dept., UC Riverside; Former Staff Research Associate, UC Riverside.

BIOCONTROL OF TURF DISEASES

William L. Casale[1]

Environmental and health concerns have led to increasing restrictions on the use of chemical pesticides. In response, we must reduce our reliance on chemicals to control diseases of turfgrass, and, indeed, all agricultural and horticultural plants. Alternative disease control methods include biocontrol, the use of "beneficial" microorganisms to inhibit the growth or reduce the populations of pathogens (microorganisms that cause disease) or otherwise interfere with their ability to cause disease. Such beneficial microorganisms are also referred to as "microbial antagonists" of a pathogen. Several different activities of microbial antagonists may be involved in biocontrol. Antagonists may exclude or restrict pathogens by out-competing them for nutrients or space. Many microorganisms produce chemicals that inhibit growth or kill pathogens. Some microorganisms prey upon or parasitize pathogens. It has also been suggested that beneficial microorganisms may stimulate the plants own defenses against pathogens.

There are several general strategies to exploit microbial antagonists for biocontrol. One promising strategy is to introduce a complex mixture of microorganisms as occur, for example, in compost. Although, at present, the disease suppressiveness of a particular compost cannot be predicted, research is underway to better understand the chemical and biological processes involved. A related approach is to enhance the activity of beneficial microorganisms already present at a particular site through the use of organic or other amendments. In this case, the level of disease suppression depends upon the indigenous microorganisms so, again, disease suppressiveness is not predicatable. Some success has been demonstrated by applying specific microorganisms that have been selected for their potential effectiveness in biocontrol. Perhaps the most effective methods will combine specific, effective biocontrol agents with methods that enhance the activity of a complex mixture of microorganisms.

My laboratory is in the second year of a project using aspects of all the above approaches to develop biocontrol methods for soilborne turfgrass diseases. We are investigating sites where turf disease has declined naturally for potential sources of information and beneficial microorganisms to use in biocontrol. We hypothesize that in some cases, increased activity of antagonistic microorganisms may be associated with disease decline expressed at a site over several seasons or within the green, recovered central areas that often appear within brown, symptomatic patches of turf as the disease spreads. We have isolated and tested many bacteria and fungi isolated from suspected disease decline sites. In laboratory tests, a number of these microorganisms produced antibiotics that inhibited growth

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Plant Pathologist, Plant Path. Dept., UC Riverside

of Sclerotium rolfsii (cause of southern blight) and Rhizoctonia solani (cause of brown patch). Some fungi also parasitized these fungal pathogens. Tests with Leptosphaeria korrae (cause of spring dead spot) are also underway. Several potential biocontrol agents reduced disease of perennial rye caused by S. rolfsii and R. solani in greenhouse tests.

BIOLOGY AND CONTROL OF BLACK TURFGRASS ATAENIUS

Richard Cowles

The black turfgrass ataenius (BTA), Ataenius spretulus, is a common and damaging pest of golf course greens, collar areas, and tees in California. First reported to be damaging five years ago in the Coachella Valley, it has since been reported in San Diego County, Orange County, the central valley, and Marin County. The adult beetle is shining black, 5 mm (1/5 inch) long, with lengthwise parallel grooves on its elytra (wing covers). This beetle can be confused with two other species found in turf in California.

Ataenius desertus, or desert ataenius, are 2.5 mm long brown or reddish-brown beetles. They are commonly found attacking highly stressed turf in the Coachella Valley, however, because of their small size, they are much less likely to cause damage than BTA. The larvae may be virtually identical (except in size) to BTA.

Aphodius lividus adults are 4.5 mm long, the color of dark chocolate, with straw-colored markings along the margins of the elytra and on either side of a dark stripe down the middle of the back. They arrive in very high numbers at recently aerated greens; probably are attracted to odors associated with black-layer. This species is not known to directly feed on turf roots.

Unlike other scarab beetle "white grubs," BTA have more than one generation per year, allowing them to build up to populations well over 100 grubs per square foot. Population surveys at any time of year can detect most life stages of this species, therefore there are probably overlapping generations developing at all times of the year. This agrees with observations of continuous adult activity throughout the spring and summer at heavily affected golf courses.

Three monitoring methods can be used to determine whether you need to treat for these grubs and to time pesticide applications. Blacklight traps (a bug-zapper with a pail underneath to catch the beetles) are effective for monitoring general levels of adult activity. However, the catches may be influenced by the brightness of competing light sources, such as the moon. Adults can also be monitored by visual inspection of the greens. During mid-day, the number of beetles observed on the surface may be less that 5% of the live beetles in a green - flooding (1/4 inch irrigation) can assist by driving the adults out of the ground so that they may be counted. Finally, cup cutter samples should be regularly inspected for grub activity.

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Ext. Entomologist, Entomology Dept., UC Riverside.

Different grass species, environmental and growing conditions will affect whether turf will show injury from BTA. Bermudagrasses are so vigorous that it would be unusual to observe damage to this species in a fairway. The opposite extreme is poorly adapted species, like creeping bentgrass, kept at a short mowing height and with poor root development. In these stressful situations, apparent "dry spots" caused by root loss will develop with as few as 5-6 BTA grubs per cup cutter core (50-60 grubs per square foot) during mid-summer. Larger numbers of grubs can be tolerated as the health of grass is improved. Keeping a higher cutting height during the summer, using water injection aeration, and other practices that maintain healthier and deeper root systems could all improve tolerance of grass for root feeders.

A summary of pesticide and nematode efficacy for control of BTA grubs is on an accompanying hand-out. Though chemical treatment thresholds will vary with the condition of the turf, preliminary "rules of thumb" are that insecticides should be applied to susceptible turf approximately two weeks after a peak in adult activity where: (1) a large number (5 beetles/sq. ft.) of adults are observed or where (2) cup cutter samples disclose greater than an average of five grubs per core.

BERMUDAGRASS AND ZOYSIAGRASS WINTER COLOR

V. A. Gibeault, S. Cockerham, M. Leonard and R. Autio[1]

Common and hybrid bermudagrasses are used as warm season grasses in California for various turf purposes. Their deep root system, low water use rate and good drought resistance mechanisms, good traffic tolerance during warm months and low pest susceptibility are all positive characteristics of the bermudagrasses. Similarly, zoysiagrasses are well adapted to southern California but, at present, are not widely established for general or specific turf purposes. One of the reasons the warm season grasses are not used more extensively in California is due to their characteristic winter dormancy, which is due to the degradation of chlorophyll by the interaction of low temperature and high light intensity. Several UCR studies have evaluated new, recently developed experimental lines and existing cultivars of bermudagrass and zoysiagrass for turfgrass quality and winter color.

Thirty-two cultivars and lines of bermudagrass were established at the UC South Coast Field Station at Irvine and at UC Riverside in 1986. From November 1988 to March 1989 and during the winter of 1991-92, winter color ratings were collected on a weekly basis, with results averaged on a monthly basis.

Fourteen experimental and four commercially available zoysiagrasses were established in 1988 at the UC Riverside Turfgrass Research Project. Color retention was rated on the 18 zoysigrasses during the late fall and winter of 1991-92.

It was found that the hybrid bermudagrasses held color during low temperatures better than common bermudagrasses. The following cultivars and lines were best at color retention: Tifway, Tifway II, Santa Ana, CT 23, NM 375 and MSB 10.

Regarding zoysiagrasses, the commercial varieties 'Meyer' and 'Belair' were the first selections to go dormant. This started in early November and appeared to be unrelated to temperature, which was mild and favorable for growth of warm season grasses. 'El Toro' was the next variety to exhibit significant color loss although it never went completely dormant. 'Emerald' maintained the best winter color of the four commercial varieties, but was inferior to many of the experimental lines.

Of the UCR experimental lines, Z88-3, Z88-8 and Z88-14 demonstrated exceptional winter color retention. Z88-11 also exhibited very good color. These lines sustained only a minimal decline in color quality throughout the winter.

In conclusion, it has been shown that considerable variation exists in the winter damage pattern of cultivars and lines of bermudagrass and zoysiagrass. Several experimental lines of zoysiagrass appear to offer the potential of year-around green during moderate winter conditions of southern California.

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Ext. Environmental Horticulturist, Botany & Plant Sci. Dept., UC Riverside; Supt., Agric. Operations, UC Riverside; Staff Research Associates, Botany & Plant Sci. Dept., UC Riverside respectively.

LIGHT INTENSITY TURF EVALUATION (L.I.T.E.)

CITATION II PERENNIAL RYE (PLANTED 7/91)

2	3	4	1	2	3	4	1	2	3	T
	2	3	4	1	4	1	2	3		NT
4	2	1	4	3	3	4	2	1	1	T
	3	4	1	2	1	2	4	3		NT
3	4	3	1	2	4	1	3	2	4	NT
	3	1	2	4	1	4	2	3		T
1	4	2	1	3	3	4	1	2	2	T
	1	2	4	3	1	2	3	4		NT
4	3	1	2	4	2	1	4	3	3	NT
	4	3	1	2	4	3	1	2		T
1	3	2	4	1	1	4	2	3	2	NT
	2	1	4	3	3	1	2	4		T
2	1	2	3	4	4	1	3	2	3	NT
	2	4	1	3	1	3	2	4		T
1	3	2	1	4	4	3	1	2	4	T
	2	4	3	1	3	1	2	4		NT

N

MAIN TREATMENTS

1. 73% SHADE
2. 55% SHADE
3. 30% SHADE
4. 0% SHADE

SUB-SUB PLOTS

1. IRON ROOTS
2. ROOTS (NO IRON)
3. CHELATED IRON
4. CONTROL (NO TREATMENT)

SUB-PLOTS

TRAFFIC
NO TRAFFIC

TURFGRASS DISEASE CONTROL

R. A. Khan

Disease plays a major role in determining the success of a turfgrass stand. It is often the single most important factor limiting the successful growth of a cultivar or species. For a disease to occur, three conditions are necessary: a susceptible host (e.g. cool or warm season grass), a virulent pathogen (e.g. Pythium sp.), and a favorable environment for infection. If any one of them is missing, disease will not develop.

In southern California, the rainfall during spring this year and mismanagement have been contributing factors to many diseases caused by Pythium sp. Crown and root rots are mostly associated with this fungus, which thrives in water-logged soils where drainage is a problem.

Equally important is seed rot and damping-off caused by several species of fungi (Pythium sp., Rhizoctonia, Fusarium sp., and Helminthosporium sp.). In this case, seed-rot, pre-and post-emergence damping-off affect a turfgrass stand from its inception, leaving entire areas with yellow, stunted, and often dead seedlings. Good surface and sub-surface drainage, aeration in the seedbed, and seeding at the recommended depth will ensure healthy emerging seedlings.

There are other diseases which devastate turfgrass stands. These include Brown Patch (Rhizoctonia solani), Fusarium Patch (Fusarium nivale), Melting Out (Bipolaris sp.), Spring Dead Spot (Leptosphaeria korrae), and Take-all Patch disease (Gaeumannomyces graminis). In some cases, many turfgrass species are seriously affected and either do not survive the growing season or grow very poorly for a long time. Of importance is the correct diagnosis of the disease so that appropriate control measures can be applied.

Rust disease occurs on all turfgrass species. Early symptoms appear as yellow spots on leaves or stems. These enlarge, resulting in pustules which may be yellow or orange and appear powdery to the touch. Recommendations for control include nitrogen fertilization and thorough infrequent irrigation, especially in the early part of the day.

Developing and applying effective management strategies will result in preventing or controlling most diseases with a minimum of effort and delay. Most turfgrass diseases are easier to prevent than to cure. Following recommended cultural practices will aid in the establishment of aesthetically pleasing stands of turfgrass. Such practices include proper mowing height, adequate fertilization, frequent aerification, and growing the correct variety for a particular geographic area and environment.

[1] Staff Research Associate, Agric. Operations, UC Riverside.

CALIFORNIA TURFGRASS DISEASE GUIDE

DISEASE	SYMPTOMS	SUSCEPTIBLE GRASSES	CONDITIONS FAVORING DISEASE	CULTURAL CONTROL	FUNGICIDAL CONTROL
Warm Season Diseases					
Anthracnose (*Colletotrichum graminicola*)	Irregular patches of diseased turf 2 to 12 inches in diameter. Leaf blotches are brown fading to light tan. Fungus forms minute black fruiting structures (acervuli) on dead grass blades.	All grasses, especially *Poa annua* and bentgrasses	Disease is most severe under high temperatures (80-90°F), wet conditions and low soil fertility.	Apply adequate balanced nutrients. Reduce irrigation frequency consistent with vigorous growth of turf.	chlorothalonil fenarimol mancozeb triadimefon thiophanate
Curvularia Blight (*Curvularia* spp.)	Thinning-out of grass or irregular patches and streaks. Leaves yellowed and then becoming brown. Colonization of leaves occurs through cut tips of senescent leaves.	Bentgrasses *Poa annua*	Favored by high temperatures and adverse growing conditions.	Improve growing conditions.	See Leaf Spot.
Fairy Ring Several species of mushrooms cause fairy rings. In northern and central California, the predominant fungus is *Marasmius oreades*: *Lepiota* spp. are predominant in southern California.	A dark-green band of turf develops in a circle or semi-circle. Mushrooms may or may not be present. Frequently just behind the dark-green band is an area of sparse, brown, dying grass caused by lack of water penetration. Weed invasion is common.	All grasses	Fairy ring develops most frequently in soil high in undecomposed organic matter containing lig-nin. Thus, adding woody plant materials favors fairy ring development.	Apply adequate nitrogen. Aerate soil for better water penetration and water heavily in holes for 3 to 5 days.	Complete soil sterilization. Methyl bromide* Soil wetting agent may be helpful.
Fusarium Blight (*Fusarium culmorum* and *F. tricinctum*) Fungi survive in the soil and turf as resting structures. Spread is by infected clippings or contaminated equipment.	The disease first appears as small circular greyish green areas a few inches up to a foot in diameter. Some plants in the centers of spots may survive producing a frog-eye spot. The crown or basal area of the dead stems is affected with a reddish rot and is hard and tough. The dead foliage becomes bleached in appearance.	Park, Campus, Fylking, and Nugget are the most susceptible; A-34, Baron, Merion, Victa, Windsor, and the new cultivars, such as Adelphi, Bonnieblue, Geronimo, Majestic Parade, and Rugby are much less susceptible.	Disease is favored by daytime air temperatures of 85-95°F and night temperatures of 70°F or above. Disease occurs most commonly in areas that have been stressed for moisture and areas in full sun. The disease is also favored by excessive nitrogen fertilization.	Irrigate frequently to avoid moisture stress in the plants. Keep the litter or debris on top of the soil moist but not overly wet. Avoid heavy nitrogen applications. Use 20% perennial ryegrass when seeding.	Complete control with fungicides has not been attained in California. Triadimefon is most effective. benomyl fenarimol iprodione mancozeb thiophanate

DISEASE	SYMPTOMS	SUSCEPTIBLE GRASSES	CONDITIONS FAVORING DISEASE	CULTURAL CONTROL	FUNGICIDAL CONTROL
Summer Patch (*Magnaporthe poae*)	Circular yellow or tan areas up to one foot in diameter of dead and dying plants. Stolons are affected by a dark, black rot. Youngest roots may appear healthy.	Bluegrasses *Poa annua* Fine fescues Resistant Kentucky bluegrasses include: Adelphi, Emmundi, Sydsport, and Touchdown.	Favored by high temperatures (83-95°F). Disease is most severe at high soil moisture levels.	Promote root growth by aeration. Improve drainage and reduce compaction.	Apply 3-4 weeks before symptoms likely to appear. benomyl fenarimol* thiophanate triadimefon (Water in after application)
Pythium Blight (Grease Spot) (*Pythium* spp.) Fungus forms thick-walled, sexual spores, which enable it to survive in the soil for long periods.	Turf is killed in small, roughly circular spots (2 to 6 inches) which tend to run together. Blackened leaf blades rapidly wither and turn reddish-brown. Leaf blades tend to lie flat, stick together, and appear greasy. Roots may be brown.	All grasses.	Pythium blight (grease spot) usually appears in low spots that remain wet. Disease depends on excessive moisture. Pythium may be very destructive at high temperatures (80 to 95°F).	Reduce shading. Improve soil aeration and water drainage. Irrigate when needed to a depth of 4 to 6 inches.	metalaxyl chloroneb fosetyl-Al mancozeb
Rhizoctonia Blight (*Rhizoctonia solani*) Formerly called Brown Patch. A soil-inhabiting fungus active as fine fungal threads that survive in the soil or in and on the turf. Hard masses of fungal threads (sclerotia) are very resistant to fungicides.	Small, irregular brown areas that may enlarge to many feet in diameter. Centers of spots may recover, resulting in rings of diseased grass. Leaves and leaf sheaths become water-soaked, wilt, turn light brown and die. Stems, crowns, and roots may also be infected. In light attacks roots are usually not involved and plants recover.	Bentgrasses Bermudas Bluegrasses Fescues Ryegrasses Zoysia *Poa annua*	Excess thatch and mat. High temperatures (75 to 95°F), high humidity, and soft, lush growth due to excess nitrogen favor brown patch. Disease is more common in warm, inland areas.	Reduce shading. Improve soil aeration and water drainage. Irrigate when needed to a depth of 4 to 6 in, if possible. Avoid nitrogen fertilization that results in a soft foliage growth.	benomyl captan chlorothalonil fenarimol iprodione mancozeb quintozene thiophanate thiram triadimefon
Sclerotium Blight (*Sclerotium rolfsii*) Fungus survives in the thatch as sclerotia. Fungus is spread by sclerotia and infected plant parts.	Circular areas up to 9 ft. in diameter. Some plants may remain alive in centers of spots. Abundant white mycelium growth as fungus advances. Light to dark brown sclerotia 1/32 to 1/16 inch in diameter are diagnostic.	Bentgrasses Bluegrasses Fescues Ryegrasses Dichondra and many kinds of plants.	Warm or hot weather, high moisture, and heavy thatch.	Keep thatch down. Aerating and verticutting can spread the fungus sclerotia.	quintozene (water in the fungicide) triadimefon

* Use with caution on *Poa* species.

DISEASE	SYMPTOMS	SUSCEPTIBLE GRASSES	CONDITIONS FAVORING DISEASE	CULTURAL CONTROL	FUNGICIDAL CONTROL
Smut, Loose (*Ustilago cynodontis*) Fungus is perennial in the plant. Spores are airborne and contaminate seed. Spores infect germinating seeds and young stolons.	Flower heads are replaced by masses of dark spores.	Bermudas	Warm weather and conditions that promote flowering.	Keep grass growing vigorously. Remove flower heads by mowing before spores are produced.	Treat seed with captan or thiram. Fungicides used for stripe smut might be effective.
			Moderate Season Diseases		
Dollar Spot (*Sclerotinia homeocarpa*) Fungus survives in the soil by means of sclerotia. Disease is common near the coast, especially on creeping bentgrass and *Poa annua*.	Small, circular areas of turf, about 2 inches in diameter. Spots may merge to form large, irregular areas. Leaves are water-soaked at first and then they later turn brown and finally become straw-colored. Fine, white, cobwebby hyphae may be seen in early morning.	Bentgrasses Bermudas Bluegrasses Fescues Ryegrasses *Poa annua*	Moderate temperatures (60 to 80°F), excess moisture or water-stress, fog and excess mat and thatch favor dollar spot. Turf deficient in nitrogen tends to develop more dollar spot than turf adequately fertilized.	Keep thatch at a minimum. Irrigate only when needed to a depth of 4 to 6 in. but do not stress the plants between irrigations. Apply adequate nitrogen.	fenarimol triadimefon benomyl thiophanate vinclozolin iprodione chlorothalonil mancozeb thiram
Necrotic Ring Spot (*Leptosphaeria korrae*)	Large ring-shaped patches, often causing depressions in turf. Roots and crown are brown or black.	Bluegrasses *Poa annua* Fine fescues	Favored by cool conditions in the spring and early fall.	Maintain mowing height of 2 inches or higher. Overseed with pereninial ryegrass.	benomyl fenarimol* Iprodione
Leaf Spot (*Bipolaris sorokiniana*) Fungus survives in infected grass plants or grass debris. May be seedborne. Spores are airborne.	Same as for Melting Out, except leaf spots usually show brown rather than straw-colored centers; borders of spots are purplish to dark brown.	Bentgrasses Bermudas Bluegrasses Fescues Ryegrasses	Favored by warm temperatures (70 to 90°F) and high humidity. Most damaging on closely clipped turf. More severe under high nitrogen fertilization.	Reduce shade. Improve aeration and water drainage. Avoid dry spots.	captan chlorothalonil iprodione maneb mancozeb thiram

* Use with caution on *Poa* species.

DISEASE	SYMPTOMS	SUSCEPTIBLE GRASSES	CONDITIONS FAVORING DISEASE	CULTURAL CONTROL	FUNGICIDAL CONTROL
Leaf Blotch (*Bipolaris cynodontis*) Fungus survives in infected bermudagrass plants and debris. May be seedborne. Spores are airborne.	Tiny purplish to reddish spots occur on leaf blades and leaf sheaths. Seedlings are very susceptible, but plants rapidly become resistant. Affected seedlings wither, die, and turn brown. Roots and crown may develop small lesions.	Bermudas	Leaf blotch damages young seedlings or adult plants weakened by factors such as excess thatch, nitrogen deficiency, and unfavorable growing conditions.	Remove thatch at regular intervals. Apply adequate nitrogen.	Fungicides usually are not necessary. captan chlorothalonil iprodione maneb mancozeb thiram
Powdery mildew (*Erysiphe graminis*)	Gray-white cobwebby growth on upper leaf surface. At first in isolated patches spreading to give grey-white appearance to leaves. In advanced stages leaf blades may turn pale yellow.	All grasses. Disease most severe on Kentucky bluegrass.	The disease is most severe in shady areas with high humidity and poor air circulation with air temperatures about 65°F.	Improve air circulation; reduce shading.	triadimefon fenarimol
Rust (*Puccinia striiformis*, *P. graminis* and *P. coronata*) Disease overseasons in infected grasses.	Elongated, reddish pustules containing spores on stems, leaves, and leaf sheaths. Reddish spores adhere to fingers when pustules are rubbed.	Bluegrass Ryegrasses	Moderately warm, moist weather favors rust development. Moisture in the form of dew for 10 to 12 hours is sufficient for spores to infect plants.	Keep plants growing rapidly by nitrogen fertilization and irrigation. Mow grass at weekly intervals.	triadimefon chlorothalonil maneb mancozeb
Smut, Stripe (*Ustilago striiformis*) Fungus spores formed in the leaves can contaminate seed and infect seedlings. Young tillers are also infected. Fungus is perennial in the plant.	Infected plants are often pale green and stunted. Long, black stripes of spore pustules occur in leaves. Infected leaves curl, later die, and become shredded.	Bentgrasses and Bluegrasses. <u>Resistant cultivars</u>: Adelphi Baron Bonnieblue Glade Newport Park Sydsport Touchdown	Favored by moderate temperatures. Disease is prevalent in the spring and fall. Infected plants may die in hot, dry weather.	Plant resistant cultivars.	benomyl fenarimol thiophanate triadimefon Treat seed with captan or thiram.

DISEASE	SYMPTOMS	SUSCEPTIBLE GRASSES	CONDITIONS FAVORING DISEASE	CULTURAL CONTROL	FUNGICIDAL CONTROL
			Cool Season Diseases		
Fusarium Patch (*Microdochium nivale*) Also called Pink Snow Mold. Fungus overseasons in grass residues. Commonly observed only in central and northern California; rarely found in southern California.	Roughly circular patches 1 to 2 inches may enlarge to 12 inches. Leaves first become water-soaked. They later turn reddish-brown, then become bleached. Minute white or pinkish, gelatinous spore masses are occasionally seen on dead leaves. Fungal threads, also white or pinkish, may be seen in early morning.	Bluegrasses Fescues Ryegrasses Zoysia Common on *Poa annua* and creeping bentgrass.	Cool (40 to 60°F), moist conditions, such as prolonged rainy periods in winter, favor the disease. High nitrogen applied in the fall favors the disease. More severe when soil pH is neutral or alkaline.	Reduce shade. Improve soil aeration and water drainage. Avoid excess nitrogen fertilization, especially in the fall. Adjust pH to 6.5-6.7.	benomyl fenarimol iprodione mancozeb thiophanate triadimefon vinclozolin
Melting Out (*Drechslera poae*) Fungus survives in infected bluegrass plants or grass debris. May be seedborne. Spores are airborne.	Circular to elongated purplish or brown spots with straw-colored centers occur on leaf blades, leaf sheaths, and stems. Leaf spots are general, indicating spread by windborne spores. Crown and roots are frequently affected with a dark brown rot. Crown-infected plants are weakened and may die in hot, windy weather, resulting in a thinning out of the turf in scattered areas.	Kentucky bluegrass. Many improved selections are resistant, including: Adelphi, Bristol, Destiny, Eclipse, Enmundi, Glade, Ikone, Liberty, Majestic, Mona, P-104, Rugby, and Somerset.	Cool (50 to 75°F), moist conditions favor the disease. First appears on shaded plants. Most severe on closely clipped turf, and high nitrogen fertilizations.	Reduce shade. Improve soil aeration and water drainage. Avoid dry spots. Do not mow grass lower than 1.75 inches.	iprodione quintozene vinclozolin chlorothalonil mancozeb thiram captan maneb
Red Thread (*Laetisaria fuciformis*) Disease overseasons as pinkish or red, gelatinous crusts of fungus threads. It commonly occurs along the coast of northern and central California. It is rare in southern California.	Turf may be killed in patches 2 to 8 inches in diameter; or the disease may occur over large areas without killing. Pink web of fungal threads binds leaves together. Pink gelatinous, 1/4 to 3/4-inch-long fungal crusts projecting from leaves are diagnostic.	Bentgrasses Bluegrasses Fescues Ryegrasses Bermudagrasses	Red thread usually appears on plants deficient in nitrogen and during periods of prolonged cool, wet weather.	Apply adequate nitrogen. Reduce shading.	chlorothalonil fenarimol iprodione mancozeb triadimefon vinclozolin

DISEASE	SYMPTOMS	SUSCEPTIBLE GRASSES	CONDITIONS FAVORING DISEASE	CULTURAL CONTROL	FUNGICIDAL CONTROL
Spring Dead Spot (*Leptosphaeria korrae*) The fungus survives in debris as hyphae and sclerotia. The fungus is spread by sclerotia and infected plant parts.	Circular areas of dead grass, 6 to 12 inches in diameter, occur as the turf resumes growth in spring. Spots may coalesce to form large areas.	Bermudagrass	Affects dormant plants. Most severe when temperatures are in the mid- to low 50's.	Remove dead grass. Fertilize in the late summer to maintain vigor. Overseeding with ryegrass may be beneficial.	fenarimol Apply in September.
Take-all Patch (*Gaeumannomyces graminis* var. *avenae*) Formerly called Ophiobolus Patch. The fungus survives in grass debris and living grass plants.	Circular or ring-shaped dead areas a few inches and up to 3 feet or more in diameter. Dying bentgrass at the advancing margins has a purplish tinge. The roots of diseased plants are rotted. Dark strands of mycelium visible on surface of roots. Large black perithecia in dead tissues may be visible with a hand lens.	*Agrostis* spp. Bluegrasses Fescues Ryegrasses	In California, Take-all Patch principally occurs in the late fall and winter. Soil conditions that favor the disease include light texture, low organic matter, low or unbalanced fertility and high pH. The disease also is favored by high moisture conditions.	Improve growing conditions; drainage, pH, fertility. Replant with less susceptible grasses. Fertilize in the fall with ammonium chloride.	fenarimol triadimefon
			<u>All-Season Diseases</u>		
Seed Rot and Damping Off Disease may be caused by several fungi; *Pythium* spp., *Rhizoctonia solani*, *Fusarium roseum* or *Helminthosporium* spp.	Seed rot and pre- and post-emergence damping off may occur. Seed rot is rather dry but not mushy. Hypocotyl area is particularly susceptible. At first, seedlings are water-soaked. They then blacken, shrivel, and turn brown. In general, affected seedlings are not killed, but are yellow and stunted, with markedly reduced root systems.	All grasses	Seed rot and damping off are favored by excessive moisture and sowing seeds of low viability above the recommended rates especially during periods unfavorable for seed germination and growth. Do not plant seeds of cool-season grasses during hot weather.	Improve soil aeration and water drainage. Sow only fresh, healthy seed at recommended rates and seasons. Do not overwater.	Treat seed with thiram or captan. Spray seedlings with captan or thiram. Fumigate soil before planting with methyl bromide.
Pythium Root Rot *Pythium* spp.	Poor growth is a result of rotted roots. Small, bleached patches may progress to large dead areas.	All grasses	Favored by poor drainage and excessive water.	Improve drainage. Do not overwater.	metalaxyl fosetyl-Al

TURF FUNGICIDES (Active ingredients and corresponding trade names) Mercury and cadmium compounds are not included.

benomyl = methyl 1-(butylcarbamoyl)-2-benzimidazole-carbamate: Tersan 1991.

captan = N-trichloromethylthio-4-cyclohexene-1,2-dicarboximide: Orthocide, captan.

chloroneb = 1,4-dichloro-2,5-dimethyoxybenzene: Terraneb, Scotts Fungicide V.

chlorothalonil = tetrachloroisophthalonitrile: Daconil 2787, Best Turf Disease Control, Turf Care, Scotts 101BS Fungicide.

etridiazole = 5-ethoxy-3-trichloromethyl-1,2,4-thiadiazole: Koban, Terrazole. (No longer sold in California)

fenarimol = α-(2-chlorophenyl)-α-(4-chlorophenyl)-5-pyrimidinemethanol: Rubigan.

iprodione = 3-(3,5-dichlorophenyl)-N-(1-methylethyl)-2,4-dioxo-1-imidazolidenecarboximide: Chipco 26019, Fungicide VI.

mancozeb = coordination product of zinc ion and manganous ethylenebisdithiocarbamate: Dithane (DF, F-45, M-45), Fore, Best Multipurpose Disease Control, Penncozeb.

maneb = manganese ethylenebisdithiocarbamate: Tersan LSR.

metalaxyl = N-(2,6-dimethylphenyl)-N-(methoxyacetyl) alanine methyl ester: Pace, Subdue, Scotts Pythium Control.

quintozene = pentachloronitrobenzene: Fungiclor, Terraclor, Best Turf Fungicide, Scotts FF II, Turfcide.

thiram = tetramethylthiuram disulfide: D & P, Spotrete, Turf-Tox, Thiramad, Thiuran 75, Chipco Thiram 75.

thiophanate-methyl = dimethyl (1,2-phenylene) bis (iminocarbonothioyl) bis (carbamate): Cleary's-3336, FungoFlo, Fungo 50, Scotts Systemic Fungicide.

triadimefon = 1-(4-chlorophenyoxy)-3,3-dimethyl-1-(1H-1,2,4-triazol-1-yl)-2-butanone: Bayleton, Scotts Fungicide VII.

vinclozolin = 3-(3,5-dichlorophenyl)-5-ethenyl-5-methyl-2,4-oxazolidinedione: Vorlan.

COMBINATIONS

Broadway = chlorotholonil + fenarimol.

Bromosan = thiophanate + thiram.

Duosan = thiophanate-methyl + mancozeb.

Pace = metalaxyl + mancozeb.

Scotts Fertilizer Plus Fungicide VIII = thiophanate-methyl + iprodione + fertilizer.

Scotts Fluid Fungicide = thiophanate-methyl + iprodione.

Scotts Fluid Fungicide II = triadimefon + metalaxyl.

Scotts Fluid Fungicide III = triadimefon + thiram.

Spectro = + thiophanate.

SOIL FUMIGANTS

dazomet = tetrahydro-3,5-dimethyl-2H-1,3,5-thiadiazine-2-thione: Basamid

metham-sodium = sodium methyldithiocarbamate: Vapam, Soil-Prep.

methyl bromide*: Bed Fume, Bromex, Brom-o-gas, Dowfume MC-2, MBC Fumigant, Pestmaster Soil Fumigant, Tribrome, Weedfume, etc.

- Arthur H. McCain
Extension Plant Pathologist

Department of Plant Pathology
University of California
Berkeley, CA 94720

June, 1992

*Permit for possession or use required from County Agricultural Commissioner.

ALPHABETICAL LISTING OF FUNGICIDES

PRODUCT	ACTIVE INGREDIENT	PRODUCT	ACTIVE INGREDIENT
Banner	propiconazole	Rubigan	fenarimol
Basamid	dazomet	Scotts Fertilizer Plus Fungicide VI	triadimefon + fertilizer
Bayleton	triadimefon	Scotts Fertilizer Plus Fungicide VIII	thiophanate-methyl + iprodione + fertilizer
Bed Fume	methyl bromide	Scotts FF II	quintozene + fertilizer
Best Multipurpose Dis. Ctrl.	mancozeb	Scotts Fluid Fungicide	thiophanate-methyl + iprodione
Best Turf Disease Control	chlorothalonil	Scotts Fluid Fungicide II	triadimefon + metalaxyl
Broadway	chlorothalonil + fenarimol	Scotts Fluid Fungicide III	triadimefon + thiram
Bromex	methyl bromide	Scotts Fungicide V	chloroneb
Bromo-o-gas	methyl bromide	Scotts Fungicide VI	iprodione
Bromosan	thiophanate + thiram	Scotts Fungicide VII	triadimefon
Captan	captan	Scotts Pythium Control	metalaxyl
Chipco 26019	iprodione	Scotts Systemic Fungicide	thiophanate-methyl
Chipco Thiram 75	thiram	Soil-Prep	metham-sodium
Cleary's 3336	thiophanate-methyl	Spectro	+ thiophanate
D & P	thiram	Spotrete	thiram
Daconil 2787	chlorothalonil	Subdue	metalaxyl
Dithane (DF, F-45, M-45)	mancozeb	Terraclor	quintozene
Dowfume MC-2	methyl bromide	Terraneb	chloroneb
Duosan	thiophanate-methyl + mancozeb	Terrazole	etridiazole
Fore	mancozeb	Tersan 75	thiram
FungoFlo	thiophanate-methyl	Tersan 1991	benomyl
Fungo 50	thiophanate-methyl	Thiramad	thiram
MBC Fumigant	methylbromide	Thiuran 75	thiram
Ortho Liquid Lawn Dis. Ctrl.	chlorothalonil	Tribrome	methyl bromide
Orthocide	captan	Turf Care	chlorothalonil
Pace	metalaxyl + mancozeb	Turfcide	quintozene
Penncozeb	mancozeb	Turftox	thiram
Pestmaster Soil Fumigant	methyl bromide	Vapam	metham-sodium
ProTurf DSB Fungicide	benomyl	Vorlan	vinclozolin
		Weedfume	methyl bromide

ROOT GROWTH OF WARM-SEASON TURFGRASSES DURING DROUGHT

Janet Hartin[1]

While root growth and development varies among and within turfgrass species, dehydration avoidance is more prevalent in some species than others. Dehydration avoidance is a component of drought resistance that includes the maintenance and enhancement of water uptake and/or reduced evapotranspiration (ET).

Several studies have characterized bermudagrass as a dehydration avoider, due to its ability to develop a deep, dense root system and close stomates. Conversely, zoysiagrass ranks low in dehydration avoidance, due to a relatively shallow root system. Zoysiagrass does exhibit a dehydration tolerance form of drought resistance believed to be a function of osmoregulation and desiccation tolerance.

During drought conditions, a high root:shoot ratio may develop. Moderate water stress may stimulate deeper rooting. In some studies, root length density (RLD) of zoysiagrass decreased as moisture stress increased, while bermudagrass possessed equal or better RLD, enhancing its drought avoidance mechanism. Under continued water stress, however, turfgrass root systems will decline and eventually die. Root mass of bermudagrass between 30 - 150 cm has been positively correlated with qualitative turfgrass ratings, although carbohydrate distribution has not shown an association.

Nitrogen fertilization during heat stress can reduce root growth by diverting carbohydrate reserves in roots to activities related to increased shoot growth. Water stress often occurs because the root system cannot absorb soil water quickly enough to replace transpiration loss. Potassium increases root production and may also increase drought resistance.

Raising mowing height increases ET and root growth. The practice of increasing mowing height during drought may be beneficial for lines of bermudagrass that have the potential to root deeply, since more soil water may be exploited.

Soil compaction from traffic and heavy equipment can greatly decrease the dehydration avoidance mechanism of bermudagrasses. Oxygen diffusion rates (ODR) in compacted soils are severly reduced, limiting oxygen and, therefore, root growth. Roots that do continue to grow are unable to penetrate deeper soil strata, diminishing drought avoidance mechanisms. Under compacted conditions, root hair development is decreased, leading to reduced water and mineral absorption. Minimizing practices favoring compaction and using cultivation practices conducive to increasing soil aeration are recommended.

[1] Farm Advisor, Univ. of Calif., Coop. Ext., San Bernardino Co.

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UCR TURFGRASS RESEARCH - PROJECT SUMMARY

Starting Date July 1991 Plot No. Field 16H
Completion Date -

Project Title: Field evaluation of UCR Kikuyugrass selections.

Objective: Evaluate field performance of advanced Kikuyugrass selections. Establishment rate, shoot density, and color quality are of particular interest.

Investigator(s):
Name R. Shaw Dept. B/PS Phone X4660
Name M. Leonard Dept. B/PS Phone X3898

Species/Cultivars: Kikuyugrass (Pennisetum clandestinum)

Management: Mowing Frequency 1 x/wk. Height 0.75 in.
Fertilizer - Material Urea (46-0-0) Rate 1# N/1000 ft^2/2 Mo.
Irrigation - __ as needed 60 %ET_0 __ Other (specify below)
Special

Experimental Design: __ CRD X RCB __ SPLT __ Other
No. of Reps 3 No. of Treatments 20 Treat. Plot size 6' x 8'
Rep size 30' x 60' Total Plot size 90' x 60'
Treatments: 20 Kikuyugrass selections (17 from UCR breeding program and 3 California selections).

Data Collection: 1) Variable Area/Spread Frequency Weekly
2) Variable Color Frequency Weekly (Winter)
3) Variable Density Frequency -

Special Instructions/Comments:

KIKUYU FIELD SELECTION TRIAL

1	8	9	3	15	13	16	4	19
6	17	10	1	11	19	7	3	8
5	18	20	7	14	20	2	11	1
3	19	7	6	9	10	17	6	14
15	2	11	16	5	18	12	15	9
4	16	13	2	8	12	10	20	5
12	14	X	17	4	X	13	18	X
	I			II			III	

↑ N

KIKUYU SELECTIONS

1. K-14
2. K-19
3. K-36
4. K-50
5. K-76
6. K-92
7. K-130
8. K-154
9. K-163
10. K-169
11. K-171
12. K-218
13. K-225
14. K-257
15. K-261
16. K-289
17. K-294
18. C-1
19. C-11
20. C-17

EVALUATING SOIL AMENDMENTS AND POLYMERS FOR USE IN THE LANDSCAPE

Jim Downer[1]

Polymers and other soil amendments are frequently recommended for incorporation in soil before planting turfgrasses. Addition of amendments may increase water holding content, improve cation exchange capacity, add nutritional elements, and increase biological activity in soils, but some amendments may not have significant effects or can be harmful. Composted amendments high in salt or micronutrients such as boron may injure sensitive plants. Over-amending can cause layered soils in which turfgrass roots will not grow well. Poorly composted organic matter may deplete nitrogen from soils.

New products are always under development, thus giving turfgrass and landscape installers many amendment choices. With current emphasis on water shortages, water saving amendments (polymers) are frequently advocated for turfgrass establishment. There is need for a rapid, easy method to test amendment suitability for landscapes.

The objectives of this study were to develop a system for evaluation of soil amendments. The system should allow for observations of plant performance (growth, percent cover, etc.) and tolerance to drought. Water-use of different plant materials could also be estimated.

A study was prepared to test attributes of six amendments on performance of turfgrass and a groundcover in containers. A standard nursery propagation flat (17 x 16 x 2.5 in.) held various amendments which were mixed into 83% sand soil at four rates with three repeats. Flats arranged in a randomized complete block design and placed edge to edge were planted with turfgrass (Pacific Sod Inc.'s Penblue, a mix of perennial ryegrass and Kentucky bluegrass) and a groundcover (Potentilla), and allowed to establish.

Percent cover was monitored during establishment. During an unintended dry-down, water was withheld for five days (see table). Survival and injury were rated for all flats. Normal irrigations were restored to flats and subsequent dry-downs were postponed until greater cover was achieved. The first (intended) dry down was from 7/20/92 to 7/23/92. Reference Evapotranspiration (ET_o) during the period was .35 in.

These preliminary results suggest that differences between soil amendments can be discerned within a couple of months using a standard flat. Care should be given to place treatment flats in the same exposure to sun, wind and reflective surfaces so as not to bias the test. Treatments should be arranged randomly. Local ET_o was estimated within the trial using a Livingston atmometer and was highly correlated with flat water loss. Dry downs were rapid and effective in the flats, with severe plant

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Farm Advisor, Univ. of Calif., Coop Ext., Ventura County.

injury occurring in 5 days. There were no advantageous effects from the use of polymer. Peatmoss promoted the best establishment overall while composted sludge showed the most growth inhibition early on, but had the fastest recovery and growth rates later. Given the right rates of incorporation, several of the organic amendments may enhance early performance of turf and. groundcovers. Further dry downs are planned.

Cover and drought tolerance ratings for turfgrass and groundcover growing in flats with various soil amendments.

Treatment	% Cover[1]				Drought Rating[2]		Flat E.T.[3]
	6/1	6/30	7/8	8/13	6/30	7/8	7/20-7/23
		drought		post drought			
Polymer	18.3	32.9	21.8	34.8	3.8	6.6	.38
Peatmoss	31.5	46.7	33.3	61.3	4.9	6.5	.48
Shavings	16.4	31.0	23.8	37.7	4.4	6.9	.35
Yardwaste	20.6	38.3	26.5	37.6	4.5	6.8	.33
Sludge	13.4	35.8	20.7	42.6	4.9	7.1	.41
Porus Ceramic	17.9	30.4	20.8	38.3	4.0	6.5	.40
Significance of Main Effects[4]	***	***	*	***	ns	ns	(***)-(***)

1

Cover estimates are percent of 16 x 17 in. nursery propagation flat occupied by plant material, estimated visually. Drought was imposed on 6/26/92 and water restored on 7/1/92 (5 days).

2

Drought ratings are estimates of plant injury/death; 1 = dead and 10 = healthy.

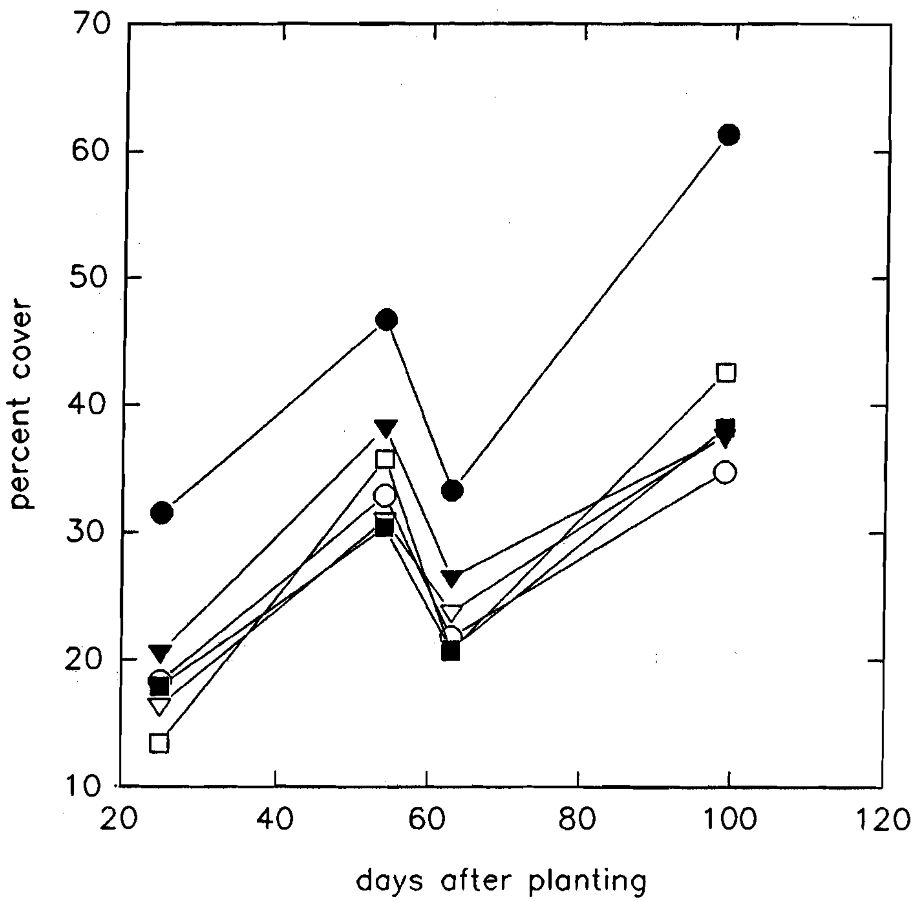
3 Flat E.T. is the evapotranspiration of water (inches) from the flat-soil and plant surfaces over the dated period. ET_o (reference evapotranspiration) during the period was .35 in.

4

Main effects of amendment source: NS, *, *** Not significant at P=0.05 or 0.001 respectively.

Establishment of turf and ground covers in various soil amendments

- ○ Polymer (Viterra Gelscape)
- ● Peatmoss
- ▽ Wood Shavings
- ▼ Composted Yardwaste
- □ Composted Sludge
- ■ Porus Ceramic (Isolite)



- –Percent cover estimated visually.
- –Points represent means of all rates and both plant species for a given amendment.
- –Main effects are significant at P=.001 .

> –A 5 day drought was imposed on day 50 after which normal irrigations were resumed.

UCR - TURFGRASS RESEARCH CENTER - PROJECT SUMMARY

Starting Date May 86 Project No. ______
Completion Date ______ Plot No. 13

Title: National Bermudagrass Trial

Objective: To evaluate Bermudagrass in southern California.

Investigator(s):
Name V. A. Gibeault Dept. Coop. Ext. Phone X3575
Name R. Autio Dept. Coop. Ext. Phone X4430

Species/Cultivars: 32 Bermudagrass cultivars

Management: Mowing Frequency 1 x/Wk. Height 3/4" in.
Fertilizer-Material ______ Rate 1# N/M/6 wk.
Irrigation - /X/ as needed ______ % ET_0 / /Other (Specify Below)
Special ______

Experimental Design: / / CRD /X/ RCB / / SPLT / / Other ______
No. of Reps 3 Size of Rep. ____ x ____ Total Plot ____ x ____
Treatments: ______

Data Collection: 1) Variable Turfscore Frequency Monthly
2) Variable ______ Frequency ______
3) Variable ______ Frequency ______

Special Instructions/Comments: ______

MEAN TURFGRASS QUALITY RATINGS OF BERMUDAGRASS CULTIVARS
IN THE 1986 NATIONAL BERMUDAGRASS TEST AT RIVERSIDE, CA
1990 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=BEST

NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
ENTRY 32	4.7	5.0	6.3	7.0	7.0	7.0	5.0	7.0	8.0	8.0	6.0	6.0	6.4
TIFWAY	4.0	4.0	6.3	7.0	7.0	7.0	5.7	6.7	8.3	8.3	7.0	5.7	6.4
TIFWAY II	4.0	4.3	5.7	6.0	6.0	7.3	5.0	7.7	9.0	9.0	7.3	6.0	6.4
MSB-10	4.0	4.0	6.7	7.3	7.3	7.3	5.3	6.7	7.7	7.7	6.3	5.0	6.3
NM 471	4.0	4.0	6.0	7.0	7.0	6.3	6.0	6.3	7.3	7.3	6.3	4.7	6.0
A-22	4.0	4.0	6.7	7.7	7.7	6.7	5.0	7.0	6.7	6.7	5.0	4.0	5.9
CT-23	4.7	4.0	6.0	6.0	6.0	5.7	4.7	6.0	7.3	7.3	6.7	6.0	5.9
MIDIRON	4.0	4.0	7.0	8.0	8.0	7.3	6.0	6.0	5.7	5.7	4.3	4.0	5.8
MSB-30	4.0	4.0	5.3	6.7	6.7	7.0	7.3	7.3	6.3	6.3	5.0	3.7	5.8
NM 43	4.0	4.0	6.0	7.0	7.0	6.7	6.0	6.3	6.3	6.3	5.3	4.0	5.8
E-29	4.0	4.0	6.0	6.7	6.7	7.0	6.0	6.3	6.7	6.7	4.7	4.0	5.7
RS-1	4.0	4.0	5.0	6.0	6.0	8.0	7.0	8.0	6.0	6.0	4.0	4.0	5.7
TUFCOTE	4.0	4.0	6.3	7.0	7.0	6.7	5.3	6.3	6.3	6.3	5.0	4.0	5.7
ENTRY 29	4.0	4.0	6.3	6.7	6.7	6.0	5.3	5.7	6.0	6.0	6.3	4.3	5.6
NM 375	4.0	4.0	6.0	6.0	6.0	6.7	5.7	6.3	6.3	6.3	5.0	4.7	5.6
NM 507	4.0	4.0	6.0	6.7	6.7	7.0	7.7	6.3	5.7	5.7	4.0	4.0	5.6
TIFGREEN	4.0	4.0	6.0	6.3	6.3	5.7	6.0	6.0	7.0	7.0	5.0	4.0	5.6
A-29	4.0	4.0	5.3	6.0	6.0	6.7	6.7	6.7	6.0	6.0	5.0	4.0	5.5
ENTRY 31	3.0	4.3	5.0	6.7	6.7	6.0	6.7	6.3	6.3	6.3	4.7	4.0	5.5
MSB-20	4.0	4.0	6.0	6.3	6.3	6.0	6.0	6.7	6.0	6.0	5.0	4.0	5.5
NMS 3	4.0	4.0	5.3	6.3	6.3	7.0	5.7	7.0	5.7	5.7	4.7	4.0	5.5
TEXTURF 10	4.0	4.0	5.0	5.7	5.7	6.0	6.3	6.3	6.7	6.7	5.0	4.3	5.5
ENTRY 30	3.3	4.0	5.7	6.0	6.0	6.3	5.3	6.0	5.7	5.7	5.7	4.7	5.4
NMS 4	3.0	4.0	5.0	6.3	6.3	6.7	5.7	6.0	6.0	6.0	4.7	3.7	5.3
VAMONT	4.0	4.0	6.0	6.3	6.3	6.0	5.7	5.7	5.3	5.3	4.0	4.3	5.3
FB-119	4.0	4.0	5.3	5.7	5.7	6.0	5.3	6.0	5.3	5.3	5.0	4.3	5.2
GUYMON	4.0	4.0	5.0	5.7	5.7	6.0	6.0	6.3	5.7	5.7	4.3	4.0	5.2
NM 72	2.3	4.0	5.7	6.0	6.0	6.0	6.0	6.0	5.3	5.7	4.3	3.7	5.1
NMS 1 (NUMEX-SAHARA)	4.0	4.0	5.0	5.0	5.0	6.3	6.0	7.0	5.0	5.0	5.0	4.3	5.1
NMS 2	4.0	4.0	5.0	5.0	5.0	6.0	6.0	6.3	5.7	5.7	4.7	4.0	5.1
AZ. COMMON	4.0	4.0	5.0	5.0	5.0	6.0	5.3	5.3	5.0	5.0	4.7	4.7	4.9
NMS 14	4.0	4.0	4.3	4.7	4.7	5.0	5.7	5.7	5.7	5.7	4.0	3.7	4.8

NATIONAL BERMUDAGRASS TEST, 1986

Entries and Sponsors

Entry No.	Name	Sponsor
1	CT-23	Cal-Turf, Inc.-Camarillo, CA
2	NM 43	A. Baltensperger - New Mexico State University
3	NM 72	A. Baltensperger
4	NM 375	A. Baltensperger
5	NM 471	A. Baltensperger
6	NM 507	A. Baltensperger
7	Vamont	L. Taylor - Va. Tech
8	E-29	Kansas State University
9	A-29	Kansas State University
10	RS-1	H. Rice, A.J. Powell- University of Kentucky
11	MSB-10	J. Krans - Miss. St. Univ.
12	MSB-20	J. Krans
13	MSB-30	J. Krans
14	A-22	Kansas State University
15	Texturf 10	Texas A & M University
16	Midiron	-
17	Tufcote	-
18	Tifgreen	-
19	Tifway	-
20	Tifway II	-
21	NMS 1 (NuMex-Sahara)	A. Baltensperger & Farmers Marketing Corp.
22	NMS 2	A. Baltensperger
23	NMS 3	A. Baltensperger
24	NMS 4	A. Baltensperger
25	NMS 14	A. Baltensperger
26	Arizona Common	-
27	Guymon	Agriculture Processors - Enid, OK
28	FB-119	A. E. Dudeck - University of Florida

NOTE: Entries 21-27 are seeded bermudagrasses.

UCR - TURFGRASS RESEARCH CENTER - PROJECT SUMMARY

Starting Date June 1991 Project No. ______
Completion Date ______ Plot No. 18

Title: NTEP Zoysia Trial

Objective: To evaluate zoysia varieties in southern California

Investigator(s):
Name V.A. Gibeault Dept. Bot & Pl Sci Phone X3575
Name R. Autio Dept. Bot & Pl Sci Phone X4430

Species/Cultivars: 28 zoysia cultivars

Management: Mowing Frequency 2 x/Wk. Height 3/4 in.
Fertilizer-Material ______ Rate 1# N/M/6 wk.
Irrigation - /X/ as needed ______ % ET_0 / /Other (Specify Below)
Special ______

Experimental Design: / / CRD /X/ RCB / / SPLT / / Other ______
No. of Reps 3 Size of Rep. 60 x 30 Total Plot 60 x 90
Treatments: ______

Data Collection: 1) Variable Turfscores Frequency Monthly
2) Variable ______ Frequency ______
3) Variable ______ Frequency ______

Special Instructions/Comments: ______

ZOYSIA NATIONAL VARIETY TRIAL
(Plot #18)

↑ N

I	19	18	4	1	26	7	16
I	8	28	2	25	11	20	14
I	21	13	3	15	10	23	9
I	22	12	17	5	24	6	27
II	6	23	27	28	5	12	3
II	7	19	11	22	10	17	25
II	24	1	26	14	4	13	21
II	15	18	16	9	2	8	20
III	28	4	10	11	2	24	9
III	19	18	5	6	13	22	25
III	20	15	27	12	23	3	16
III	17	21	7	1	8	14	26

VARIETIES

1. TC2033
2. GT2047
3. CD2013
4. TC5018
5. GT2004
6. CD259-13
* 7. Korean Common
* 8. JZ-1
9. Meyer
10. Emerald
11. Belair
12. Sunburst
13. El Toro
14. DALZ8514
15. DALZ8512
16. DALZ8516
17. DALZ8507
18. DALZ8508
19. DALZ9006
20. DALZ8502
21. DALZ8701
* 22. TGS-B10
* 23. TGS-W10
24. DALZ8501
25. Z88-8
26. Z88-11
27. Z88-14
28. Z88-3

* Seeded variety.

6/91

UCR TURFGRASS RESEARCH - PROJECT SUMMARY

Starting Date August 1991 **Plot No.** 8
Completion Date ____

Project Title: NTEP Buffalograss Trial

Objective: To evaluate buffalograss varieties in southern California.

Investigator(s):
Name V. A. Gibeault **Dept.** Bot. & Pl. Sci. **Phone** X3575
Name R. Autio **Dept.** Bot. & Pl. Sci. **Phone** X4430

Species/Cultivars: 22 buffalograss cultivars

Management: Mowing Frequency 1 x/wk. Height 1½ in.
Fertilizer - Material ____ Rate 1# N/M/6 wk.
Irrigation - X as needed ____ %ET_0 ___ Other (specify below)
Special ____

Experimental Design: ___ CRD X RCB ___ SPLT ___ Other ____
No. of Reps 3 No. of Treatments 22 Treat. Plot size 6' x 7'
Rep size ___x___ Total Plot size ___x___
Treatments: ____

Data Collection: 1) Variable Turfscore Frequency Monthly
2) Variable ____ Frequency ____
3) Variable ____ Frequency ____

Special Instructions/Comments: ____

NTEP BUFFALOGRASS TRIAL

(Plot #8)

N ↑

	19	18	4	1	7	16	8
I	2	11	20	14	21	13	3
	15	10	9	22	12	17	5
	6	5	12	3	7	19	6
	11	22	10	17	1	14	4
II	13	21	15	18	16	9	2
	8	20	4	10	11	3	16
	17	21	7	1	8	14	2
III	9	19	18	5	6	13	22
					12	15	20

OPEN

VARIETIES

1. NE 84-609
2. NE 84-315
3. NE 85-378
4. NE 84-45-3
5. NE 84-436
6. Buffalawn
7. AZ143
8. Highlight 4
9. Highlight 15
10. Highlight 25
11. Prairie
12. Rutgers
13. Sharp's Improved
14. NTDG-1
15. NTDG-2
16. NTDG-3
17. NTDG-4
18. NTDG-5
19. Bison
20. BAM 101
21. BAM 202
22. Texoka

8/91

LANDSCAPE MANAGEMENT RESEARCH CONFERENCE

AND FIELD DAY

SEPTEMBER 16, 1992

NEW AND/OR UNDERUTILIZED CHAMAEDOREA PALMS WITH ORNAMENTAL POTENTIAL

Donald R. Hodel[1]

Chamaedorea, a group of about 100, small understory species native from Mexico to Bolivia, are horticulturally among the most important palms and are grown throughout the tropics and subtropics for landscape ornament and in temperate greenhouses for indoor use. Commonly known as bamboo palms, chamaedoreas have several attributes giving them their popularity and warranting special merit for southern California landscapes and gardens. They have neat, green, bamboolike stems with graceful crowns of leaves that make them excellent specimens for tropical accent. As understory palms they are extremely tolerant of low light and are excellent for indoor use or outdoors in shady areas while their small size makes them suitable for pot culture and use in the ever-diminishing residential yard. Mainly from tropical mountain forests, they are remarkably cold tolerant; most withstand the occasional light frost of coastal areas while a few are completely hardy for interior valleys. The genus is blessed with amazing diversity and encompasses species having either solitary or multiples stems and simple and bifid or pinnate leaves, or just about any combination thereof.

Unfortunately, the amazing wealth of horticultural diversity and potential in *Chamaedorea* has barely been tapped; only about a dozen species have been cultivated in southern California since the turn of the century. About five years ago a project was initiated concerned with the culture and horticultural taxonomy of this diverse and promising group of plants. The project has resulted in the "rediscovery" of three existing species and the discovery of two new species, all with excellent horticultural potential and meriting attention here.

Chamaedorea microspadix and *C. radicalis* have been around for many years. Both bear attractive clusters of red fruits and are the hardiest species in the genus. *C. microspadix*, a multi-stemmed species with dark green, velvety foliage, has withstood temperatures in the low 20s without damage. *C. radicalis*, a solitary-stemmed species with either a trunked or trunkless form topped with a rosette of dark green ascending leaves, has withstood temperatures in the high teens with no damage and has recovered from even lower temperatures. *C. metallica*, a relatively recent introduction, is noted for its dark bluish green bifid leaves with a metallic sheen. It is a stunning plant when used as a mass planting in a shady area or as a potted specimen. The two recent discoveries are the multi-stemmed *C. hooperiana* with thick, nearly plasticlike leaves and *C. plumosa*, a solitary-stemmed, vigorously growing, rather robust species with finely divided plumose foliage.

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Farm Advisor, Univ. of Calif., Coop. Ext., Los Angeles County.

TREE RESISTANCE TO THE EUCALYPTUS LONGHORNED BORER

Lawrence Hanks, Timothy Paine, and Jocelyn Millar[1]

Eucalyptus species vary in their resistance to attack by the Eucalyptus longhorned borer (ELB), Phoracantha semipunctata F.. However, the growing conditions of trees strongly influence their vulnerability to the beetle, and even the most resistant tree species can be killed by the borer if trees are stressed.

We have examined the resistance characteristics of a number of Eucalyptus species in California by monitoring beetle attack and tree mortality in mixed species stands of Eucalyptus. Two large plantations composed of eight-year-old trees of thirteen Eucalyptus species were used to examine the effect of water deficit on tree susceptibility to ELB. These studies revealed that some species have low resistance to borer attack (E. diversicolor, E. globulus, E. nitens, E. saligna, E. tereticornis, and E. viminalis) while others are strongly resistant (E. cladocalyx, E. dalrympleana, E. robusta, E. sideroxylon, E. trabutii).

The difference between Eucalyptus in their vulnerability to ELB are dramatic. For example, the Avalon area of Santa Catalina Island was originally planted with similar numbers of E. cladocalyx (a resistant host) and E. globulus (a susceptible host). In the last few years nearly all the E. globulus have been killed by the beetle while only a few E. cladocalyx have succumbed. The few remaining E. globulus persist in areas where they receive greater amounts of water, for example in a golf course or around a water reservoir.

Eucalyptus trees become attractive to adult ELB when the trees are stressed. Adult female ELB lay their eggs in cracks in the bark and under loose bark. The neonate larvae then burrow through the bark to feed along the cambium. The first line of defense that Eucalyptus trees have against colonization by the neonates is bark turgidity. The bark moisture content of a healthy tree will act as a barrier to neonate ELB, essentially drowning them as they try to pass through the bark. The effectiveness of this defense mechanism is compromised when a tree experiences water deficit. At some point, ELB larvae succeed in reaching the cambium and their feeding destroys the conductive tissue of the tree, preventing it from fighting back. Soon after the larvae reach the cambium, the tree is lost and death is rapid.

Eucalyptus trees may also respond to attack by ELB larvae by producing kino, a brown sticky gum-like resin that is often produced by the trees in copious amounts at the site of any type of injury to the bark. Kino may smother the larvae in their galleries before they have a chance to girdle the tree.

The ability of Eucalyptus trees to resist attack by ELB can be fostered by watering trees, by pruning trees only when the

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Post Doctorial Res. Assoc. and Asst. Professors of Entomology, Dept. of Entomology, UC Riverside.

adult beetles are not present (November-April) and by avoiding other kinds of stress such as damaging the roots by parking vehicles under trees.

MANAGEMENT PROGRAM FOR THE EUCALYPTUS LONGHORNED BORER

Jocelyn Millar, Timothy Paine, Larry Hanks and Juli Gould[1]

The Eucalyptus longhorned borer (ELB), Phoracantha semipunctata, is a large Cerambycid beetle native to Australia. It was first reported in California in the early 1980's. Since then it has spread rapidly throughout southern California and up to the Bay area, killing thousands of trees.

The borer preferentially attacks water stressed trees, so the ELB problem has been exacerbated by the recent drought. Female insects lay eggs in bark crevices. The eggs hatch, and the developing larvae rapidly girdle the tree, consuming the cambium layers; heavily attacked trees will be killed in a matter of weeks. Mature larvae pupate for several weeks, before emerging as adults. The entire life cycle from egg to adult takes about 3-8 months, depending on the season.

Chemical control of the insect is not feasible for the following reasons. First, Eucalyptus are planted over huge areas, and many trees are large, so adequate spray coverage would require enormous amounts of pesticide. Second, adults do not feed much, so that heavy doses of pesticides would be required in order for borers to pick up a lethal dose. Third, adults emerge from spring to fall, so that sprays would have to be repeated a number of times over the season. Fourth, the damaging larval stages are hidden under the bark, and so are unaffected by sprays; systemic insecticides are also of limited efficacy, because the larvae have often cut the vascular tissues by the time the infestation is noted and the systemic is applied. In the Mediterranean countries, pesticide-treated trap logs have been used, but they are costly to service and difficult to dispose of.

ELB damage can be minimized by a combination of management practices. Eucalyptus species should be matched to sites, and ELB-resistant varieties should be planted. Seedlings should be planted carefully, to ensure that a sturdy root system develops. Trees should be well watered and not stressed. Pruning should be done during winter months when ELB are not active, as ELB are strongly attracted to fresh wounds. Infested material should be removed before the new generation of ELB emerges, to break the infestation cycle. All infested wood should be chipped, buried, or burned.

In Australia, ELB are attacked by a variety of natural enemies. We are importing and mass rearing several natural enemies to release for ELB control. Use of natural enemies has many advantages. First, it involves no pesticides, and is environmentally safe. Second, once the natural enemies are established at several sites, they will spread naturally to wherever

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Asst. Professor of Entomology; Asst. Professor of Entomology; Post Doctorial Res. Assoc.; and Post Doctorial Res. Assoc., Dept. of Entomology, UC Riverside.

their ELB hosts are. Third, once established, the natural enemies will be self sustaining, representing a permanent solution to the problem. Natural enemies will not eradicate ELB completely, but will reduce ELB populations to low and non-damaging levels.

PINE BARK BEETLE MANAGEMENT WITH PHEROMONES

Timothy D. Paine[1]

Pine bark beetles in the genera Ips and Dendroctonus colonize and kill landscape and other urban forest pines. Trees suffering from water stress, injured trees, or trees planted off site are frequently the focus for attack. A threshold number of beetles is required to overcome the resistance mechanisms of the tree; the threshold varies with the size and health of any tree. The insects use volatile chemical signals, aggregation pheromones, which can attract large numbers of beetles onto a single tree. However, if too many beetles attempt to colonize the tree, the competition for food will reduce the reproductive success.

Many beetles also produce pheromone signals that turn arriving beetles away from the tree. Individuals of one species often can detect the presence of another species from their chemical odors and will turn away from the tree, avoiding other types of competition. Arrival of Ips paraconfusus and Dendroctonus brevicomis to their own pheromones was inhibited by verbenone or combinations of verbenone and ipsdienol. Use of these behavioral chemicals may provide a non-toxic pest management to protect high value trees in urban areas.

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Asst. Professor of Entomology, Dept. of Entomology, UC Riverside.

DEVELOPMENT OF LILACS (SYRINGA) AND CONSERVATION OF ROSA AND BERBERIS SPECIES FOR SOUTHERN CALIFORNIA LANDSCAPES

J. G. Waines[1]

A previous director of the UCR Botanic Gardens, Louis C., Erickson, made hybrids and selections among the progeny for lilacs (Syringa) that will grow and flower well in southern California conditions. That is, that will flower with low winter chill. One parent of the hybrids was usually 'Excel' a very floriferous cultivar, with pale mauve flowers, with good scent, in lax inflorescences. It grows and flowers well under Riverside conditions. The other parents were usually ones that would add darker colors, and better shape to the Excel inflorescence. One of the segregants is encouraging with a low chill requirement, dark flower color, and good inflorescence shape.

The wild Baja rose, Rosa minutifolia, was considered endemic from Encinada south to the Mission of San Fernando in Baja California, growing a few miles back from the ocean on the Pacific coast side. Several years ago, two plants were found growing on Otay Mesa, near the Mexican border, in San Diego Co. These are threatened by development. The Baja rose forms an attractive low shrub with bright pink flowers in the winter time. It lives through the Riverside summer heat with only and occasional watering. The Hardman Foundation gave money to investigate propagation of this endangered species. Cuttings and seeds did not propagate well. Layering of shoots that fall down, touch the soil, and root, is an efficient way to produce rooted material in the wild and in the garden. The availability of propagated material is limited.

Nevin's Barberry (Berberis nevinii) is native to coastal sage scrub in the San Fernando Valley in Los Angeles Co., San Timoteo Canyon, San Bernardino Co., and Vail Lake, southern Riverside Co. The populations are threatened by development. The San Timoteo Canyon population consists of only 11 plants. The Hardman Foundation gave funds to look at propagation of this endangered species, which is a medium shrub with bright yellow flowers in spring and bright red berries in summer, soft and hardwood cuttings taken from plants in winter or spring did not take well. Sowing seeds in late summer and fall readily produced healthy seedlings. We hope to duplicate seedlings from the 11 San Timoteo Canyon plants in the Botanic Gardens.

Steve Morgan will show slides of University Hybrid Mimulus before going out to the field plots. Flowering of plants in the field has suffered from the recent heatwave, where temperatures reached over 100^{o}F for over one week.

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Geneticist and Director of Botanic Gardens, Dept. of Botany and Plant Sciences, U.C. Riverside.

PHYTOPHTHORA ROOT ROT MANAGEMENT IN THE LANDSCAPE

D. M. Ferrin[1]

Phytophthora root and crown rots are diseases that affect a variety of annuals and perennials in both the nursery and the landscape. At least six species of Phytophthora are commonly found on ornamental plants in southern California. Depending on the host, the species of the pathogen and the environmental conditions, disease may be mild resulting in slower and reduced plant growth or it may be severe, resulting in obvious stunting, defoliation and eventual death of the plants.

The pathogens may be introduced into the landscape on the roots of plants or in soil. Additionally, P. parasitica and P. citrophthora may occur naturally in soil as these pathogens are known to cause root rots of citrus, to which much of southern California was once planted. Once established, these pathogens are extremely difficult, if not impossible, to eliminate and may persist in the soil for many years in the absence of a susceptible host.

Strategies for the management of Phytophthora root and crown rots include (1) prevention of their introduction, (2) eradication or reduction of pathogen populations in the soil following their introduction, (3) use of cultural practices to modify the environment so as to make conditions less conducive for disease development, and (4) use of fungicides. The use of disease-free plants and the early detection of these pathogens should be the first line of defense to prevent their introduction. Diagnostic kits are available commercially for the detection of Phytophthora spp. in the plant roots. The removal of obviously diseased plants and infested soil helps to reduce pathogen populations. However, mildly affected plants can thrive given the appropriate care.

Planting depth is an important consideration for those plants known to be susceptible to crown rot since planting too deeply exposes susceptible tissues to the pathogens. As species of Phytophthora are favored by high soil moisture, care should be taken prior to planting to ensure adequate drainage. Once established, plants should be watered with care so as to prevent excessive water from accumulating, particularly at the base of the plant. Mulches and soil amendments may also serve to reduce disease, both directly and indirectly through the stimulation of microorganisms that may be antagonistic to the pathogen. The choice of planting materials is an important consideration also. If the site to be planted has a history of Phytophthora root rot, plants that exhibit tolerance to the pathogen should be used. Lastly, fungicides may be used to reduce pathogen populations and slow disease development so that the plants become established to the point that they can tolerate the disease. However, to be most effective, fungicides must be applied prior to the development of large populations of the pathogen or the development of significant disease, and they must be used on a regular basis.

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Asst. Prof. of Plant Path., Dept of Plant Path., UC Riverside

STUDIES ON SHRUB IRRIGATION REQUIREMENTS

Janet Hartin[1]

Developing reliable irrigation schedules for landscape shrubs entails an understanding of the water requirements of individual species as well as density and microclimate considerations, which vary among sites.

Shrubs planted in full sun and high density multiple plantings require more water than those grown in shade and low density single plantings. Shrubs planted in median strips and parking lots require more water than those planted in open park settings.

Relative water use for several shrub species based on information obtained from the California Irrigation Management Information System (CIMIS) has been determined in pot-to-pot nursery trials. The following table ranks species water use in a simulated nursery trial under well-watered conditions, and does not indicate minimum water requirements of the shrubs under drought-induced conditions, which could alter their ranking significantly.

HIGH WATER USERS: Pyracantha augustifolia, Buddleia davidii

MEDIUM WATER USERS: Nerium oleander, Juniperus sabina, J. chinensis, J. horizontalis, Forsythia intermedia, Platycladus orientalis, Berberis thunbergii, Ligustrum japonicum, Callistemon citrinus, Cotoneaster congestus, pittosporum tobira

LOW WATER USERS: Arctostaphylos uva-ursi, Euonymus kiautschovica, Photinia fraseri, Cystisus scoparius, Mahonia repens

SOUTH COAST RESEARCH AND EXTENSION CENTER RESULTS

Photinia fraseri (Photinia), Raphiolepis indica (India Hawthorne), and Nerium oleander (Oleander) were transplanted from one-gallon containers into rows of single-species shrubs in May 1989, simulating a hedgerow planting. Plantings received 100% ET_o (reference evapotranspiration) from initial transplanting date through August 1989, at which time reduced ET_o treatments of 20, 40, or 60% ET_o were established gradually over a six month period. Treatments were reduced another 10% March 1992, resulting in 10, 30, or 50% ET_o.

Diffusive resistance, internode length, and leaf length and width were measured August 1992. Within species, no statistical differences occurred among irrigation treatments for any parameter measured. Diffusive resistance of India Hawthorne was significantly less than the other two shrub species, resulting in mean averages of 2.29 s cm^{-1} (India Hawthorne), 3.80 s cm^{-1} (Photinia) and 3.69 s cm^{-1} (Oleander). Root depth and density determinations will be made Fall 1992.

[1] Farm Advisor, University of California, San Bernardino County.

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MINIMUM IRRIGATION OF GROUNDCOVERS

Dennis R. Pittenger[1]

Landscape irrigation accounts for 25 to 30 percent of the total water used in urban areas. Studies by other researchers estimate that groundcovers occupy nearly one-fourth of the non-turf area in the Los Angeles Basin. Therefore, non-turf groundcover species account for a significant amount of the total water used in landscape areas.

The objective of this research is to determine very closely the minimum water needed to maintain the aesthetic appearance of many popular species of groundcovers. Measurements in inches and gallons of water per time period will be correlated with CIMIS ET_o calculations and scheduling data so that they can be adapted to different locales. It will be possible to package this information with that now available on turfgrass irrigation needs and that being developed for trees. Landscape designers and managers will be able to identify which species are relatively low, medium or high water users and group plant material with similar water requirements. Grouping plants in this manner could allow development of landscape and irrigation plans that provide the minimum water necessary to maintain all species resulting in 20 to 50% reduction in water applied to groundcover areas.

Six groundcover species (Baccharis pilularis 'Twin Peaks', Drosanthemum hispidum, Vinca major, Gazania hybrid, Potentilla tabernaemontanii aned Hedera helix 'Needlepoint'), representing a range of observed water needs, were evaluated under different levels of irrigation based on percentages of real-time reference evapotranspiration (ET_o). Treatments of 50, 40, 30 and 20% of ET_o have been applied continuously since June 1990.

Analysis of seasonal plant performances ratings indicates that Vinca, Gazania and Potentilla express no significant increase in their relative appearance when irrigated at more than 30% of ET_o. Baccharis, Drosanthemum and Hadera exhibited no significant improvement in performance when irrigated above 20% of ET_o. A general decline in aesthetic quality and growth was observed during the study for Gazania and Potentilla at all treatments suggesting that their long-term minimum irrigation need may be more than 50% of ET_o. The other species, however, would appear to have minimum irrigation requirements less than or equal to warm-season turfgrass species.

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Extension Urban Horticulturist, Botany & Plant Sciences Dept., UC Riverside.

QUANTIFYING HYDROCARBON EMISSIONS FROM URBAN SHADE TREES, NATURAL VEGETATION AND AGRICULTURAL CROPS

Janet Arey[1]

For the Los Angeles Air Basin, which experiences the worst air quality in the nation, to meet the National Air Quality Standard for ozone will require that hydrocarbon emissions from all sources in the basin be reduced to 200 tons day^{-1}. If the emissions from vegetation alone exceed this figure, more rigid NO_x control than is currently planned by the South Coast Air Quality Management District (SCAQMD) will be necessary to meet the ozone standard by 2010 as required in the Federal Clean Air Act.

At the Statewide Air Pollution Research Center (SAPRC) we have been involved in investigating hydrocarbon emissions from three sources: urban trees, agricultural crops and natural vegetation. Data on the emissions of hydrocarbons from natural vegetation and crops is needed to fill data gaps in the hydrocarbon inventories of the Los Angeles and other air basins. Data was collected on the emissions from urban trees because of proposals for large-scale planting of shade trees in urban areas to counteract heat-island effects and to minimize energy use. Minimizing reactive hydrocarbon emissions should be an additional criterion for tree selection for large-scale planting in urban areas experiencing ozone pollution problems. The current database on tree emissions is still very limited.

Hydrocarbon emission measurements from vegetation are made employing flow-through Teflon enclosures with solid adsorbent/thermal desorption sample collection. Gas chromatography (GC) is used to quantify the hydrocarbons and GC- mass spectrometry and GC- fourier transform infrared spectroscopy are used for hydrocarbon identification. The sampling protocol will be demonstrated and the results on emission measurements from a dozen urban trees will be available.

1 Research Chemist, Air Pollution Research Center, UC Riverside.

EVALUATING SOIL AMENDMENTS AND POLYMERS FOR USE IN THE LANDSCAPE

Jim Downer[1]

Polymers and other soil amendments are frequently recommended for incorporation in soil before planting turfgrasses. Addition of amendments may increase water holding content, improve cation exchange capacity, add nutritional elements, and increase biological activity in soils, but some amendments may not have significant effects or can be harmful. Composted amendments high in salt or micronutrients such as boron may injure sensitive plants. Over-amending can cause layered soils in which turfgrass roots will not grow well. Poorly composted organic matter may deplete nitrogen from soils.

New products are always under development, thus giving turfgrass and landscape installers many amendment choices. With current emphasis on water shortages, water saving amendments (polymers) are frequently advocated for turfgrass establishment. There is need for a rapid, easy method to test amendment suitability for landscapes.

The objectives of this study were to develop a system for evaluation of soil amendments. The system should allow for observations of plant performance (growth, percent cover, etc.) and tolerance to drought. Water-use of different plant materials could also be estimated.

A study was prepared to test attributes of six amendments on performance of turfgrass and a groundcover in containers. A standard nursery propagation flat (17 x 16 x 2.5 in.) held various amendments which were mixed into 83% sand soil at four rates with three repeats. Flats arranged in a randomized complete block design and placed edge to edge were planted with turfgrass (Pacific Sod Inc.'s Penblue, a mix of perennial ryegrass and Kentucky bluegrass) and a groundcover (Potentilla), and allowed to establish.

Percent cover was monitored during establishment. During an unintended dry-down, water was withheld for five days (see table). Survival and injury were rated for all flats. Normal irrigations were restored to flats and subsequent dry-downs were postponed until greater cover was achieved. The first (intended) dry down was from 7/20/92 to 7/23/92. Reference Evapotranspiration (ET_o) during the period was .35 in.

These preliminary results suggest that differences between soil amendments can be discerned within a couple of months using a standard flat. Care should be given to place treatment flats in the same exposure to sun, wind and reflective surfaces so as not to bias the test. Treatments should be arranged randomly. Local ET_o was estimated within the trial using a Livingston atmometer and was highly correlated with flat water loss. Dry downs were rapid and effective in the flats, with severe plant

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Farm Advisor, Univ. of Calif., Coop Ext., Ventura County.

injury occurring in 5 days. There were no advantageous effects from the use of polymer. Peatmoss promoted the best establishment overall while composted sludge showed the most growth inhibition early on, but had the fastest recovery and growth rates later. Given the right rates of incorporation, several of the organic amendments may enhance early performance of turf and groundcovers. Further dry downs are planned.

Cover and drought tolerance ratings for turfgrass and groundcover growing in flats with various soil amendments.

Treatment	% Cover[1]				Drought Rating[2]		Flat E.T.[3]
	6/1	6/30	7/8	8/13	6/30	7/8	7/20-7/23
			drought	post drought			
Polymer	18.3	32.9	21.8	34.8	3.8	6.6	.38
Peatmoss	31.5	46.7	33.3	61.3	4.9	6.5	.48
Shavings	16.4	31.0	23.8	37.7	4.4	6.9	.35
Yardwaste	20.6	38.3	26.5	37.6	4.5	6.8	.33
Sludge	13.4	35.8	20.7	42.6	4.9	7.1	.41
Porus Ceramic	17.9	30.4	20.8	38.3	4.0	6.5	.40
Significance of Main Effects[4]	***	***	*	***	ns	ns	(***)-(***)

1

Cover estimates are percent of 16 x 17 in. nursery propagation flat occupied by plant material, estimated visually. Drought was imposed on 6/26/92 and water restored on 7/1/92 (5 days).

2

Drought ratings are estimates of plant injury/death; 1 = dead and 10 = healthy.

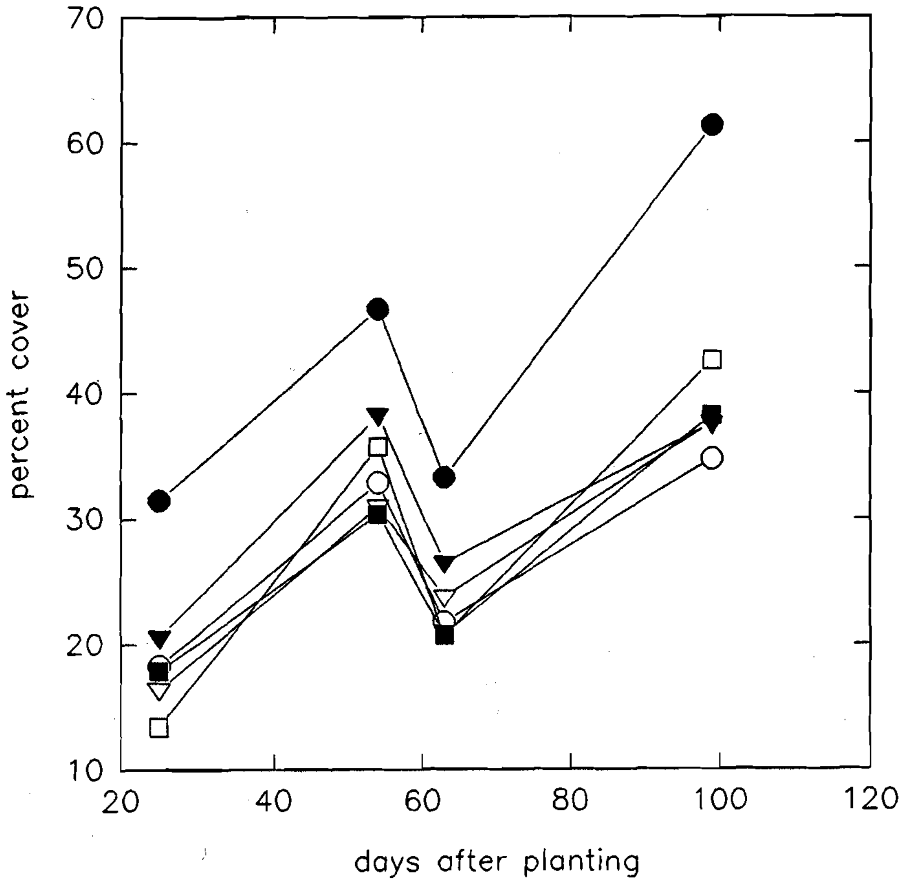
3 Flat E.T. is the evapotranspiration of water (inches) from the flat-soil and plant surfaces over the dated period. ET_o (reference evapotranspiration) during the period was .35 in.

4

Main effects of amendment source: NS, *, *** Not significant at P=0.05 or 0.001 respectively.

Establishment of turf and ground covers in various soil amendments

- ○ Polymer (Viterra Gelscape)
- ● Peatmoss
- ▽ Wood Shavings
- ▼ Composted Yardwaste
- □ Composted Sludge
- ■ Porus Ceramic (Isolite)



–Percent cover estimated visually.

–Points represent means of all rates and both plant species for a given amendment.

–Main effects are significant at P=.001 .

–A 5 day drought was imposed on day 50 after which normal irrigations were resumed.

MONKEY FLOWER (MIMULUS) HYBRIDIZATION AND SELECTION

Steve Morgan[1]

1. Background:

The shrubby, perennial species of Mimulus (Scrophulariaceae) have great potential as landscape plants for a wide range of semi-arid climates and landscape situations. They could prove useful as moderate-water bedding plants and landscape perennials, colorful nursery container plants, slope covering and stabilizing plants, and candidates for inclusion in hydroseeding seed mixes. Known commonly as "monkey flowers," they offer showy flowers in a variety of colors, a long bloom season, easy culture, easy propagation from seed and cuttings, and moderate water requirements. David Verity at UCLA made hybrids in past years and supplied the UCR Botanic Gardens with seed of 30 hybrid families to use in our work.

2. Goals:

The goal of the project is to continue hybridizing and selecting the Verity hybrid Mimulus to develop plants with bushy habit, larger flowers, improved flower color, longer bloom period, improved heat resistance and ability to withstand summer watering. We will select types that show resistance to damping-off disease in the seed bed, that propagate readily, that make healthier container stock, and that are longer-lived under moderate summer irrigation programs. Also, by successive selfings of selected cultivars, we hope to produce seed that breeds "true" for the same desirable characters. A grant from the California Association of Nurserymen supports this project.

3. Progress:

We germinated seed of many of David Verity's 30 hybrid families and seedlings were transplanted to a field on the Agricultural Experiment Station in May 1989. Plants were furrow irrigated once a week for 24 hours, which supplied about 2 in. of water each week until they were established. Cuttings of plants with desirable foliage and flower characters were taken for propagation and then planted out in separate plots to test both for drought tolerance and for ability to withstand summer watering. The selections were also propagated to test in container stock conditions. The same selections were selfed to produce seed for planting this fall and reselection spring of 1993.

1 Museum Scientist, Botanic Gardens, UC Riverside.

NURSERY CONTAINER CONFIGURATION VS. TREE ROOT AND SHOOT DEVELOPMENT

Ursula K. Schuch and Dennis R. Pittenger[1]

Trees planted in urban areas contribute to energy conservation and beautification of the environment. Unfortunately, there is a high mortality rate for trees transplanted into urban sites. Surviving trees often bring about a major long-term cost from the damage their roots inflict upon sidewalks and other paved areas. Poor tree establishment and shallow root growth after transplanting can frequently be attributed to poor root development in the original container-grown nursery stock. Recent research findings suggest that trees produced in unconventionally shaped containers and treating inner surfaces with root-inhibiting compounds may result in better quality root systems, reduced root damage to pavement and better establishment rates.

One objective of this study is to determine whether root and shoot development are influenced by container configuration (diameter x height) and volume. We will determine whether trees grown in one-, three-, and five gal. pots in tall, narrow containers will have more roots and faster shoot growth than plants grown in conventional containers of the same volume. Tree establishment and growth in the landscape will be evaluated after trees are planted in the field. The second objective will determine the effects of a root inhibiting compound on root circling in the container.

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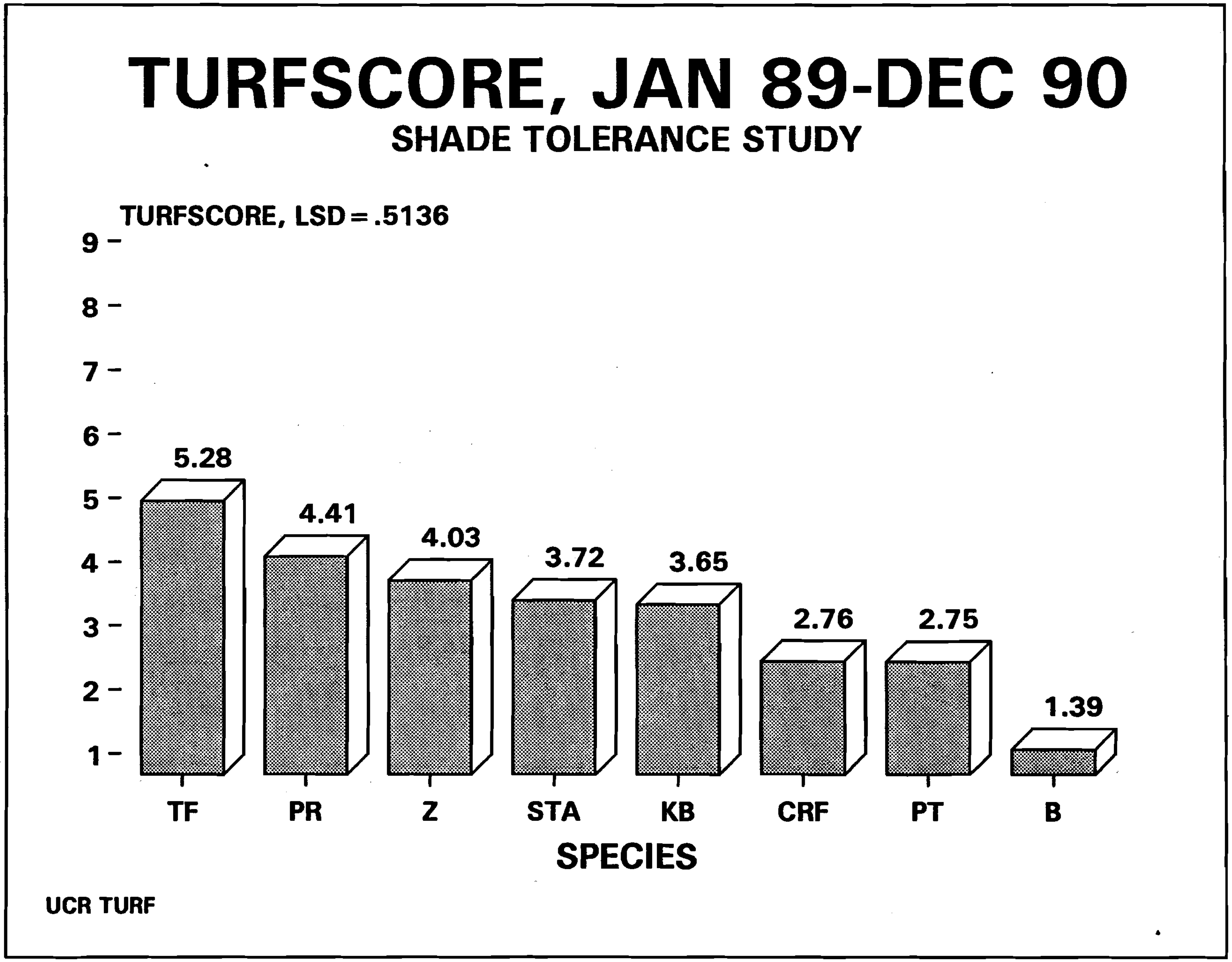
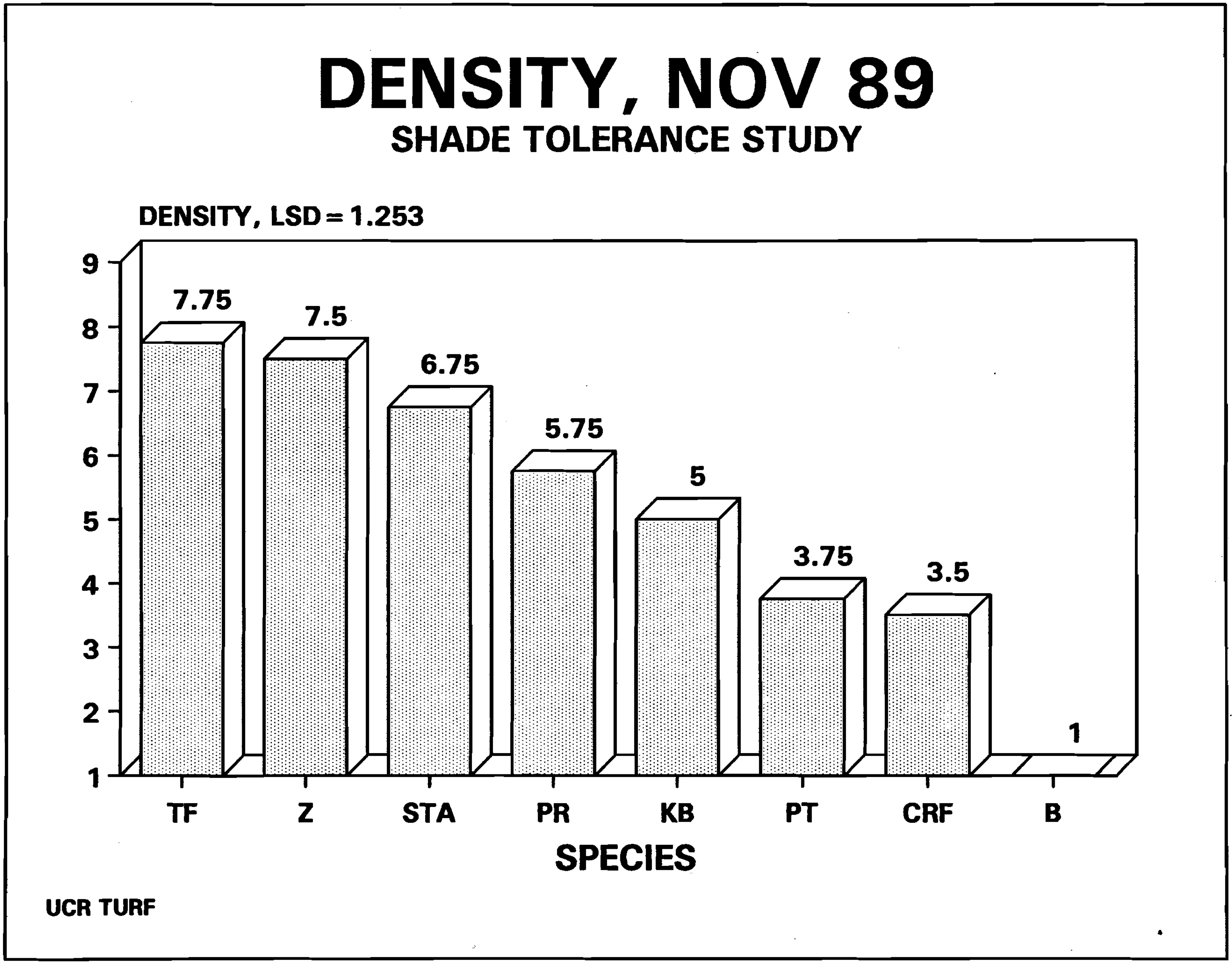
Extension Nursery Crops Specialist and Extension Urban Horticulture Specialist, Botany & Plant Sci. Dept., UC Riverside.

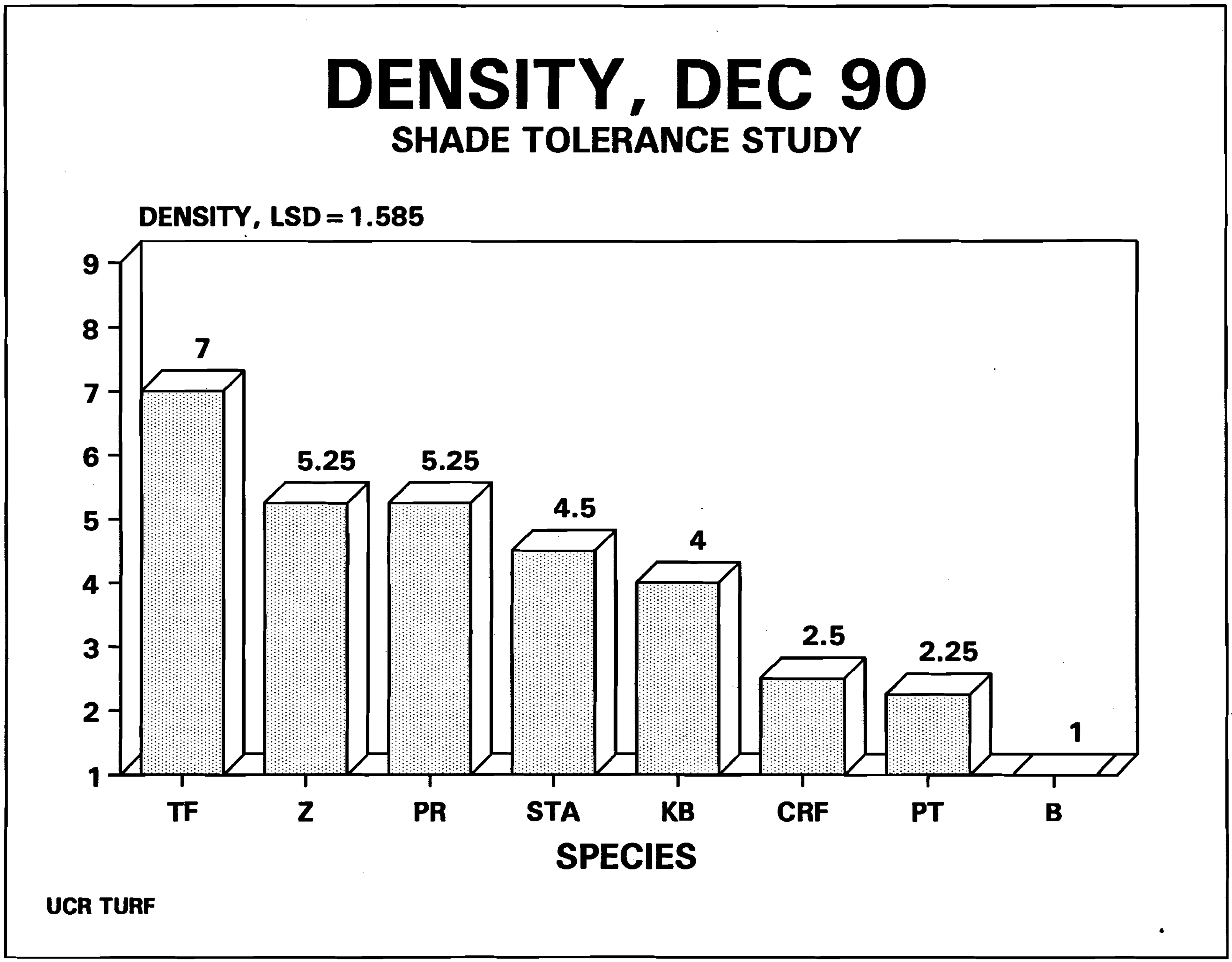
SHADE STUDY

8	8	4	2
3	5	8	5
5	6	7	3
2	3	6	6
4	2	1	7
1	7	2	1
6	1	3	4
7	4	5	8

1. COM. BERMUDA
2. ZOYSIA
3. ST. AUGUSTINE
4. CR. RED FESCUE
5. TALL FESCUE
6. POA TRIVIALIS
7. PER. RYE
8. KENT. BLUE


TURFSCORE, JAN 89-DEC 90
SHADE TOLERANCE STUDY
TURFSCORE, LSD=.5136
9
8
7
6
5
4
3
2
1
5.28
4.41
4.03
3.72
3.65
2.76
2.75
1.39
TF
PR
Z
STA
KB
CRF
PT
B
SPECIES
UCR TURF


DENSITY, NOV 89
SHADE TOLERANCE STUDY
DENSITY, LSD = 1.253
9
8
7
6
5
4
3
2
1
7.75
7.5
6.75
5.75
5
3.75
3.5
1
TF
Z
STA
PR
KB
PT
CRF
B
SPECIES
UCR TURF


DENSITY, DEC 90
SHADE TOLERANCE STUDY
DENSITY, LSD=1.585
9
8
7
6
5
4
3
2
1
7
5.25
5.25
4.5
4
2.5
2.25
1
TF
Z
PR
STA
KB
CRF
PT
B
SPECIES
UCR TURF

TREE ROOT MANAGEMENT STUDY

D. R. Pittenger

	1	2	3	4	5	6	7	8	9	10
1	D	I	F	B	J	G	H	C	E	A
2	A	B	J	C	D	E	F	G	H	I
3	C	E	I	H	B	J	A	F	D	G
4	I	C	D	G	A	H	J	E	F	B
5	H	J	G	D	E	I	C	A	B	F
6	J	A	H	I	F	C	E	B	G	D
7	E	F	C	J	G	A	B	D	I	H
8	F	D	E	A	H	B	G	I	C	J
9	B	G	A	E	I	F	D	H	J	C
10	G	H	B	F	C	D	I	J	A	E

Letter	Sp	Ba
A	1	1
B	1	2
C	1	3
D	1	4
E	1	5
F	2	1
G	2	2
H	2	3
I	2	4
J	2	5

* 2 Tree species: #1 = *Ficus nitida* and #2 = *Liquidamber styraciflua*
* 5 Root barrier treatments: 1 = Deep Root
  2 = 15 gal container
  3 = 5 gal container
  4 = 12 mil polyethylene of 15 gal vol.
  5 = check

This experiment has a 2 x 5 fully randomizable treatment design and 10 replicates arranged as a 10 x 10 Latin square.